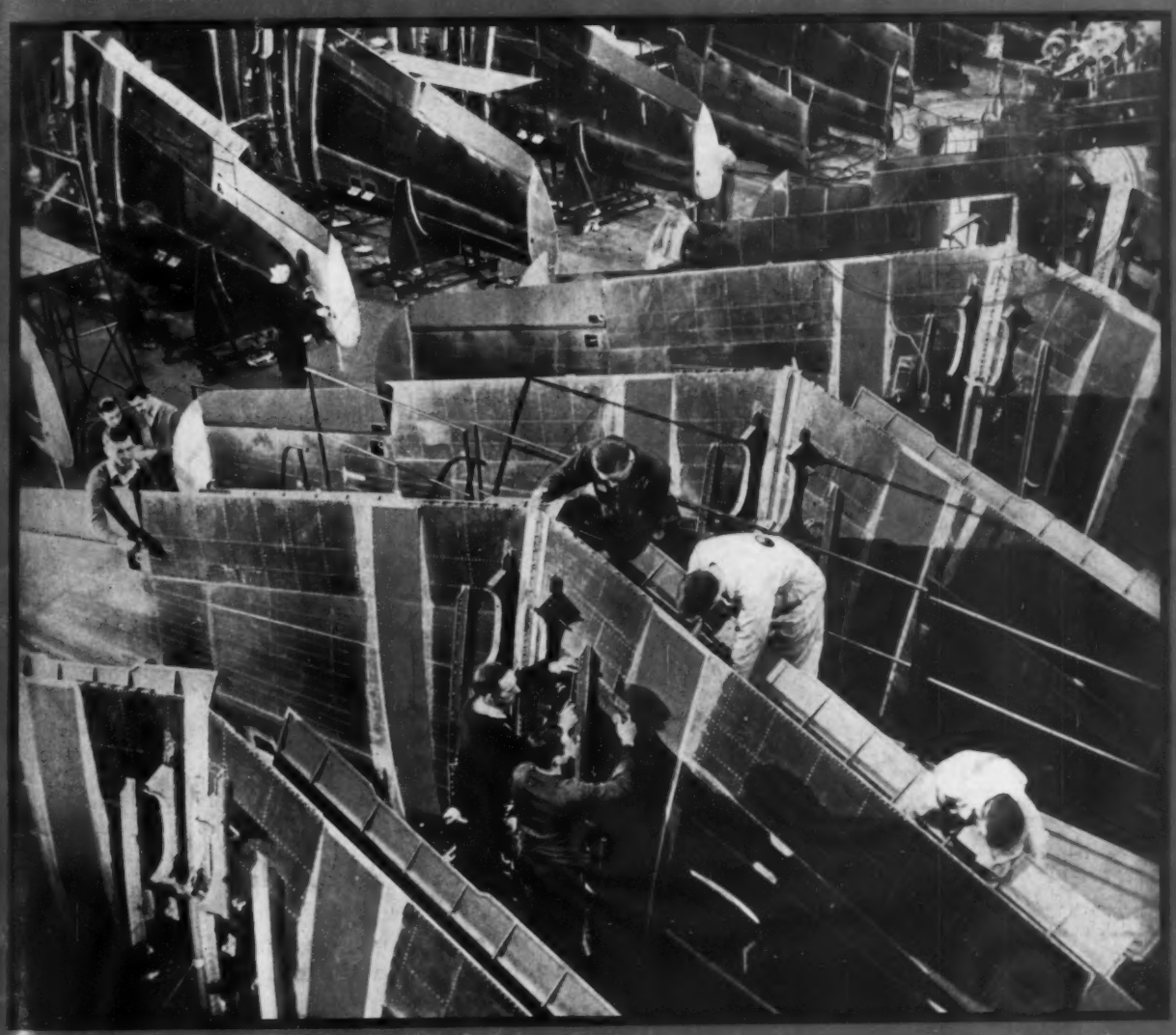
JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION



VOLUME 8 AUGUST, 1941 NUMBER 10

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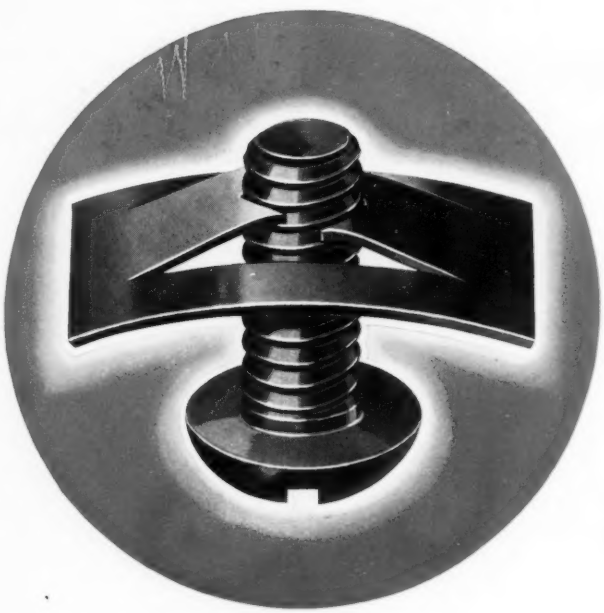

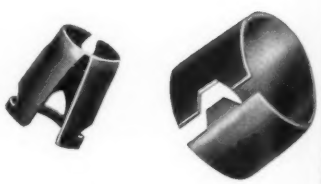

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THE numerous airplane parts and accessories being built today by Goodyear and our subsidiary Goodyear Aircraft Corporation are the products of our thirty years' experience in aeronautical engineering.

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With this veteran experience, Goodyear has extensive production facilities that make it the leading supplier of high-quality parts and accessories in its field. We are now serving aviation, just as we have long served the automobile and motor truck industries, as a dependable mass-producer of rubber and related metal essentials developed out of our long association with all types of transportation.

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Time is precious when democracy is at stake. Shipment of planes is too slow, too uncertain. Dismantling and reassembly of planes waste time. Now, new planes are being ferried to England. They are ready for service on arrival. Later, who knows, they may be ferried to South American ports, Hawaii, the Philippines, Australia. Far different from the spectacular achievements of Alcock and Brown, Lindbergh, Chamberlin, Kingsford-Smith, and others, are these unheralded flights today.

But aircraft engines today are better, more reliable. Horsepower per pound of weight has been increased by engine designer and parts manufacturer. Twenty years ago a 50-hour full-throttle block test was standard for aviation engines. Then Thompson developed silicon-chromium valves which boosted these full-throttle block tests from 50 to 300 hours. Today, Thompson sodium-cooled aviation valves often serve efficiently for 4,000 hours and over, before replacement is necessary. New types of Thompson fuel and booster pumps are helping bombers and pursuit ships climb to higher altitudes.

The ceaseless study and experiment carried on by American engine and plane builders, in which Thompson has had a chance to cooperate, today bear rich fruit in sustaining democracy.

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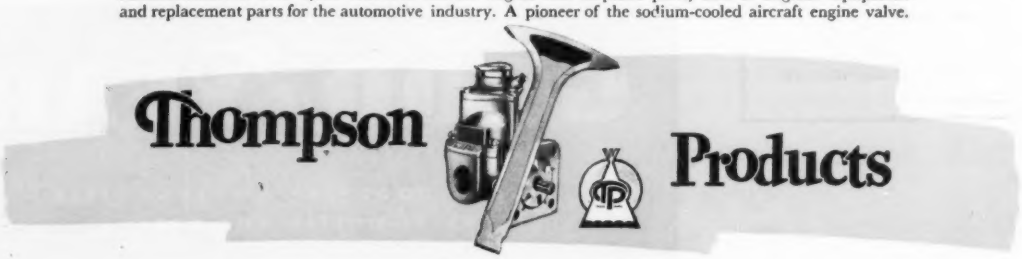

JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

AUGUST, 1941

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Publication Office: 20th & Northampton Sts., Easton, Pennsylvania
Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York, N. Y.
Published Monthly by the Institute of the Aeronautical Sciences Inc.

SUBSCRIPTION RATES

Journal of the Aeronautical Sciences including the *Aeronautical Review Section*

United States and Possessions		Foreign Countries including Canada (American Currency Rates)	
1 Year	$10.00	1 Year	$12.50
Single Copies	1.00	Single Copies	1.25

Journal of the Aeronautical Sciences *Aeronautical Review Edition Only*

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1 Year	$2.50	1 Year	$3.00
Single Copies	.25	Single Copies	.30

Entered as Second Class Matter at the Post Office, Easton, Pa., May 1, 1937. Acceptance for mailing at a special rate of Postage provided for in the Act of August 24, 1912. Authorized April 29, 1937.

Flight crews use the decompression chamber in training for high altitude flying at the Boeing Aircraft Company plant in Seattle.

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AERONAUTICAL REVIEW

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Manager

Incorporation

WHEN THE PAUL KOLLSMAN LIBRARY was endowed, it was the hope of the donors that aeronautical books would not only be made available for loaning but that readers would be informed where to find the special information they required.

The Aeronautical Review provided a record of currently published aeronautical material and the Aeronautical Reader's Guide, which was published quarterly, listed books under many different groupings. The Guide has been not only a catalogue of the books in The Paul Kollsman Library, but has also rendered an invaluable service to librarians by giving them short digests of the contents of recent aeronautical publications.

As the need for such an extensive presentation has been satisfied, the Guide will hereafter be incorporated in the book section of the Aeronautical Review. In this section annotated lists of new books as well as other accessions will continue to appear so that the Aeronautical Review will render the service formerly provided by both publications.

Consummate Conservation

At a time when defense is the most prominent thought in the public mind, the aeronautical industry is expected to turn the full force of its experience, skill and resources upon the problem of producing air weapons with increasing speed and efficiency. The extent to which the industry has applied itself and is successfuly filling its rôle in this unprecedented emergency is evidenced on all sides.

To maintain the constantly increasing demand for more and better airplanes to stem aggressive tides and fill the breach of inadequate peacetime preparation, the aeronautical industry is called upon to find ever newer means for improving the quantity and efficiency of its output. The skill of engineers and craftsmen, the development and use of constantly improved materials, techniques and facilities are not by themselves enough to do this job. All the known principles of efficiency, and even new and untried ones, must be brought to bear.

Of all known and tried principles of efficiency, there is none more axiomatic nor more all-inclusive than that of conservation—conservation of time, energy, resources. Every scientific publication today carries reports and information on conservation of energy and resources—the reclamation of waste energy and resources. The aeronautical press commands today more than ever the most thorough scrutiny and study by designers, engineers, production experts and craftsmen.

The Aeronautical Review, in affording to the aeronautical industry a synthesis of the entire industry's experience, research and progress, makes possible the utmost conservation of the industry's time in keeping abreast of ways and means for improving its job. The important factor is in getting this information not in capsule form, but rather in a form which permits ready and satisfactory selection of that published matter which provides the most intensive coverage of each individual's interests and requirements as a unit in this great defense effort.

A Quarter of a Century

Aviation magazine is receiving well-deserved commendation on its twenty-fifth anniversary of service to American aeronautics. It survived through periods of depression when all other earlier publications in the field discontinued. Now that the aeronautical industry is rapidly reaching a front rank position in dollar production volume, the natural result is a flood of books, magazines, pamphlets and house organs which are beyond the reading time capacity of any one person. Add to these the foreign output and the reason for the Aeronautical Review becomes evident.

It is becoming increasingly apparent that such a service is welcomed and is becoming a valuable aid to those persons who wish to keep abreast of current thought in aeronautics, particularly in their specialized field. To Aviation, the *oldest* American aeronautical publication, the Aeronautical Review, the *youngest*, extends its congratulations and best wishes for a continuation of its successful contribution to aeronautics.

News Review

June 11. Representative O'Leary, chairman of the House Committee on Expenditures in Executive Departments, announced that he would press for a hearing on the subject of unified air force for the U.S.

June 11. The Western Union Telegraph Company received authority from the Federal Communications Commission to spend $167,000 on a nationwide network of telegraph printing machines to be leased to the Civil Aeronautics Administration for weather reporting. The 187 printers to be provided will link 175 airports.

June 12. Wright Aeronautical Corporation opened its new 50-acre engine plant at Cincinnati.

June 13. Commander Ralph S. Barnaby, assistant chief engineer of the Naval Aircraft Factory, in testifying before the House Naval Affairs Committee, stated that experimental gliders capable of carrying both men and cargo were being built by the Navy.

June 13. Victor Emanuel, president of Aviation Corporation, testifying before the Securities and Exchange Commission, declared that motorized production lines like those recently installed at Vultee are capable of quadrupling airplane output. After the war, he said, these facilities could be used for producing low cost private airplanes.

June 14. Members of Local 365 of the United Automobile Workers, C.I.O., voted to suspend 10 leaders of an outlaw strike recently started among the 8,400 workers of the Brewster Aeronautical Corporation.

June 14. The Office of Civilian Defense appointed a special committee consisting of Guy P. Gannett, publisher, Captain Gill Robb Wilson, president of the National Aeronautic Association, and Thomas H. Beck, president of the Crowell Collier Publishing Co., to formulate plans for enrolling private airplanes and pilots for possible emergency service.

June 14. Under-Secretary of War Robert W. Patterson in a letter to Wm. P. Knudsen, Co-director of the Office of Production Management, asked for a reduction of up to 50 per cent in automobile production in order to release men, machines and management to airplane construction and other defense needs.

June 14. The British Air Ministry announced the appointment of Air Chief Marshal Sir Frederick Bowhill to the command of a new organization which will deliver American-built aircraft to England. This group will accept airplanes flown to Canada by the recently formed U.S. Army Air Corps ferry group and will fly them across the ocean.

June 15. Jesse H. Jones, Secretary of Commerce and Federal Loan Administrator, announced that he intended to provide nearly $1,000,000,000 for the building of plants for the 500-bomber-a-month program. This action was authorized under the recently enacted bill expanding the power of the Reconstruction Finance Corporation.

Lear Avia engineers remove the radio equipment from a Messerschmitt 109 for inspection and comparison with American-built aircraft radios. Note the method of installation through the side of the airplane.

June 15. The War Department announced the addition of 34 new schools to the Army Air Corps' training system. Of these, fifteen will be civilian establishments and nineteen will be Army bases.

June 16. The War Department revealed the creation of the U.S. Army Air Corps Ferry Command, designed to deliver airplanes from factories in the United States to points on the Atlantic Seaboard, where they can be shipped or flown to England.

June 16. The Glenn L. Martin Company announced the production of the 187 or Baltimore twin-engined bomber. Powered by two 1,850 hp. engines, it is reported to be as fast as the best current types of pursuit airplanes.

June 16. The new $16,000,000 Washington Airport at Gravelly Point opened for use.

June 16. Senator McCarran offered a bill providing for an independent military air force under a secretary for military aviation.

June 16. The Railway Express Agency announced a 108 per cent increase in air express for April over the corresponding month in 1940.

June 17. Juan T. Trippe, president of the Pan American Airways System, delivering the 29th annual Wilbur Wright Memorial Lecture before the Royal Aeronautical Society, predicted that within two years, passengers would be flown between England and the United States on 12-hour schedules.

June 17. All-air delivery of American aircraft across the South Atlantic via Trinidad and Brazil to Gambia was revealed as a future plan of the newly formed Air Corps Ferry Command.

June 17. Consolidated Aircraft Corporation announced the delivery of $10,450,000 worth of military and naval aircraft during May, stated to be an all-time production record for the company.

June 17. Henry Nicoll Wightman, 28, three times New Jersey gliding champion and holder of several soaring records, died at Berwyn, Md.

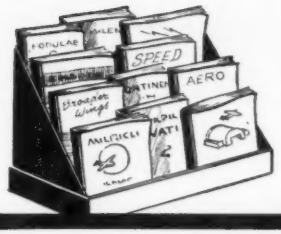
June 18. Secretary of War Stimson announced a plan for wide reorganization of the Army Air Corps, giving it a status somewhat analogous to that held by the Marine Corps in the Navy.

June 18. The Navy announced the inauguration of a $2,000,000 building expansion program at the Naval Air Station, Lakehurst, N. J. Two hangars for blimps and additional school buildings will be added.

June 19. New Army Air Corps station at Phoenix, Ariz., was named after Frank Luke, Jr., famous military pilot of the first World War.

June 19. W. G. Golien, chief pilot of the Western Division of T.W.A.

(Continued on page 37)



Periodicals

Aerodynamics

Compressibility Effects in Aerodynamics. Th. von Kármán. This paper is a review of the present status of the theory of compressible fluids from the practical standpoint of its usefulness for interpretation of experimental research and guidance in design.

Practical engineers in the design of aircraft have developed much use for the mathematical theory of fluid motion in aeronautical engineering. The various applications of the theory are based almost entirely on the hydrodynamics of incompressible perfect fluids. Recently, interest has been centered on another branch of fluid mechanics—that of the mechanics of compressible fluids.

To quote the writer, "the aeronautical engineer is pounding hard on the closed door leading into the field of supersonic motion. He realizes that the price that has to be paid for further increase of speed becomes higher and higher if he nears this frontier. However, he wonders whether the mathematical theory could not be used as a guide for avoiding a premature drop of aerodynamic efficiency." It is from this point of view that this review of the field is undertaken. *Journal of the Aeronautical Sciences*, July 1941, pages 337–335, 23 illus.

General Airfoil Theory. H. G. Küssner. On the assumption of infinitely small disturbances, the writer develops a generalized integral equation of airfoil theory which is applicable to any motion and compressible fluid. Successive specializations yield various simpler integral equations, such as Possio's, Birnbaum's and Prandtl's integral equations, as well as new ones for the wing of infinite span with periodic downwash distribution and for the oscillating wing with high aspect ratio. Finally, several solutions and methods for solving these integral equations are given. *N.A.C.A. Technical Memorandum*, No. 979, June 1941, pages 1–28.

El Arte del Vuelo Lento (The Art of Low-Speed Flying). A study of lift-increasing devices with special reference to the Fowler flap. *Aeronautica*, June 1941, pages 28–30.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Review or the Institute of the Aeronautical Sciences.

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Accessories

Clean Instruments Aid Safety in Flying. American Airlines is speeding up instrument cleaning by the use of a rotary type cleaning machine which works somewhat on the principle of a washing machine. Parts are put into a wire basket which is lowered into the cleaning solution and rotated by a small electric motor. The process is repeated in several rinsing solutions and then over a drying chamber. Details of the method are shown. *Aero Digest*, July 1941, pages 202, 205, 5 illus.

Electric Power Aloft. W. H. Fromm. Discussion of the application of fractional-horsepower electric motors to the operation of aircraft accessory equipment. *Aviation*, July 1941, pages 52, 150, 3 illus.

Nuevo Dispositivo de Arranque (New Starting Devices). A brief description of the Breeze cartridge starter, its construction and operation. *Aeronautica*, June 1941, page 45, 3 illus.

Plywood Floats for the Piper Cub Training Seaplane. Details of some new plastic-bonded plywood floats for light aircraft, which have been granted an A.T.C. Of semi-monocoque design, they are made of birch aircraft plywood, with ash keel and chine stringers. An under-carriage of welded steel tubing is said to permit a quick change from wheels to floats. *Aero Digest*, July 1941, page 155, 3 illus.

Air Conditioning for Transport Airplanes. Austin Eames Smith. Discussion of heating and ventilating systems for air transports. Necessary air temperature, volume, and types of air conditioning equipment are described. *Aero Digest*, July 1941, pages 169, 170, 173, 7 illus.

Choice and Application of Flexible Shafts in Aircraft. Herbert Chase. Series of pictures and descriptive data on flexible shaft installations in current types of aircraft. Fuel pump drives, gyro instrument drives, and flexible shaft drives for other accessories are shown. *Aero Digest*, July 1941, pages 174, 177, 178, 181, 182, 16 illus.

Airplane Descriptions

Ju 88. A description of the Junkers Ju 88, a bomber designed in 1938 as a transport plane. It was redesigned as a dive bomber and is now equipped with two 1,200 hp. liquid-cooled Jumo 211 engines. With a bomb load of 1,800 kg., it carries a fuel supply of 1,600 liters; with a bomb load of 1,000 kg., the fuel supply may be increased to 3,490 liters. The fuel tanks are of the fireproof type.

The most interesting detail of the Ju 88 is said to be the arrangement for automatic pull out of a dive. The normal diving angle of the Ju 88 is 40°. This angle is marked on the side windows of the pilot's cabin by a red line. If this red line and the horizon are in the same plane, the craft is diving at an angle of 40°. There are also lines for 50°, 60° and 70°. Some performance and specification figures are included in this description. *Flygtidningen*, April-May 1941, page 8, 2 illus.

Curtiss-Wright 21-B. Description of the Curtiss-Wright 21-B pursuit airplane. Brief data on characteristics and performance are included. *Flygtidningen*, April-May 1941, page 8, 1 illus.

Met de Interceptors de lucht in (With the Interceptors in the Air)! A comparative study of interceptor airplanes and pursuit airplanes and the work laid out for them in modern warfare. *Vliegwereld*, May 29, 1941, pages 270, 271, 2 illus.

Torpedo-Aanval (Torpedo Attack)! Capt. J. R. Hoyt. A comprehensive description of the torpedo plane and its use in modern naval warfare. *Vliegwereld*, May 22, 1941, pages 254, 255, 4 illus.

El avion Fiesseler "Storch" (The Fiesseler "Storch" Airplane). Specifications and detailed description of this airplane, which was originally built as a touring craft, but is now used extensively by the German army as a liaison and observation airplane. It is a three-place, high-wing monoplane with folding wings, has a low speed and requires only a very short take-off run. *Aeronautica*, June 1941, pages 8–10, 3 illus.

B-19—Guardian of a Hemisphere. A lengthy review of some details only recently released regarding the physical characteristics and accommodations of the world's largest bomber, the Douglas B-19. Data on performance, armament and many other details continue to be veiled due to the extensive testing yet to be undertaken and the secrecy imposed by the war.

It is now known that the airplane can carry a bomb load of 17 tons. Current proposals suggest the creation of bombs weighing 5,000 lbs. and capable of destruction over a radius of 3,000 ft.—ten times the radius of the 2,000-lb. bombs, largest in common use at the present time.

The cabin is sound-proofed, heated and has a ventilated bridge deck in the forward and upward section of the fuselage. It has a fully equipped galley and eight full-length berths to permit accommodation for full crew on flights of as much as three nights' duration. The operating crew of ten includes the commander, pilot, co-pilot, navigator, radio operator, engineer, a chief mechanic and three reserve men. Eight men, not counting reserves, are required to man the battle stations.

These and other details given reflect the general effect of the unprecedented dimensions of the airplane on the techniques developed during its production. Some discussion is given to the unique and complex technical problems which rose during the development and building of the bomber, the size of which considerably complicated both design and construction. *U.S. Air Services*, July 1941, pages 25, 26, 38, 1 illus.

The Douglas Digby. Dimensions, weights and some performance data are included in this brief description of one of the older American bombers now in service with the R.A.F. It is a military version of the Douglas DC-3 transport, designated Digby by the R.A.F. Some 250 of them under the official designation B-18A are in the service of the U.S. Army Air Corps.

Useful as a troop-carrier or a reconnaissance bomber, the airplane can accommodate 17 troops, and is suitable for carrying parachute troops. Its performance corresponds with that of the Whitley III. *The Aeroplane*, May 23, 1941, page 572.

Germany's Newest Fighter. The new Messerschmitt Me 109F single place fighter is much modified from the standard Me 109E and is equipped specially for operation at high altitude. The heavily supercharged Mercedes Benz DB. 601E motor of 1,375 hp. provides a top speed quoted at 380 m.p.h. at 21,000 ft. and a service ceiling of 38,000 ft.

Chief outward differences between the Me 109F and the older version are in the wings and tail. The wing span of 35 ft. 3 in. is 3 ft. more than that of the Me 109E; rounded wing tips replace the former square-cut tip sections. The tailplane is now unbraced and is set lower and farther forward on the fuselage.

While the armor has been increased, now having a total thickness of 18 mm. behind the pilot's seat, the armament of the Me 109F is lighter than formerly, which is in contrast to British policy in relation to new fighters. One 20-mm. cannon is mounted between the cylinder blocks of the inverted motor and fires through the hollow hub of the airscrew. Two .303-in. machine-guns are mounted on the motor cowling.

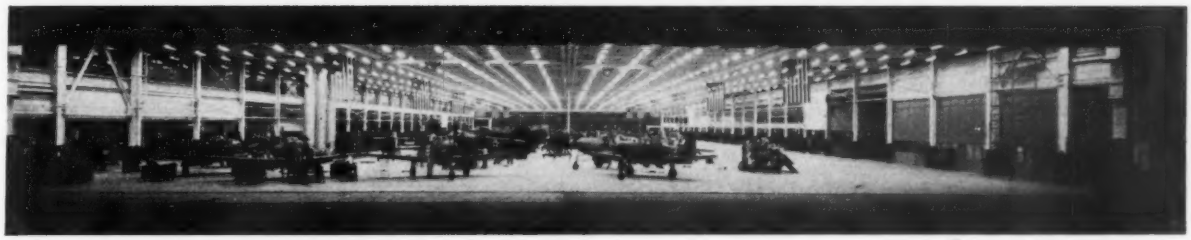
Design changes are said to indicate an insistence on performance at height, since the improvements permit a better rate of climb, better speed at height, better powers of maneuver and the carrying of extra weight. *The Aeroplane*, May 23, 1941, page 566, 1 illus.

The Grumman Martlet. Brief description of the characteristics, dimensions, weights and performance of the Grumman G-36A, said to be the fastest airplane now in service with the British Royal Navy. *The Aeroplane*, June 13, 1941, page 654, 5 illus.

Fascist Fashions. A summary of recent Italian announcements regarding details of a number of new airplanes now said to be in production in Italy. Of these, the only really new types are said to be the Breda 75; the Fiat B.G.A. twin-engined bomber, a development of the BR-20; the Caproni Ca. 313 twin-engined reconnaissance bomber, a development of the Ca. 311; and the Piaggio P. 108C four-engined monoplane, used as a bomber and transport.

The manufacturer, designation, purpose, crew accommodation, motor and top speed of thirteen Italian airplanes are listed in chart form, based on information from various sources. More extensive descriptions of some of the airplanes given in the table include specifications and performance data. *The Aeroplane*, June 20, 1941, pages 689, 690, 5 illus.

Messerschmitt 110 Construction. Further information on the Messerschmitt 110 which was sent to the Vultee Aircraft plant in California for study by American aircraft experts. The writer reports that while the airplane's offensive armament gives it heavy striking power, its defensive armament is practically nonexistent. From this, the writer concludes that the purpose of the Me 110 is to strike hard and in overwhelming numbers in typical "Blitzkrieg" manner. Included are details of airframe construction. *Canadian Aviation*, June 1941, pages 32, 33, 34, 42, 7 illus.



The Austin Company

Looking into the Bell Aircraft Corporation's new assembly plant at night from the concrete apron adjoining Niagara Falls Airport. The near-daylight illumination is produced by the first high bay fluorescent lighting ever attempted.

Fulmar Fighter. A description of a British two-place fighter known as the "Hurricane" of the Fleet Air Arm. Powered with a Rolls-Royce Merlin X engine of 1,145 hp., its high speed is probably around 300 m.p.h. The Fulmar is an all-metal, low-wing monoplane of stressed skin construction with armament consisting of eight fixed machine guns, four in either wing. Other specifications and performance data are given. *Aviation*, July 1941, page 58, 3 illus.

Twin-Engined Fighter. Details of an interesting Fokker design which closely resembles the Lockheed P-38. The model shown is powered by two 880 hp. Bristol "Perseus" X engines which give a speed far less than that of the P-38. It is stated that the Fokker G.1 is highly maneuverable, and cruising at 227 m.p.h. has a range of 1,007 miles. Armament consists of eight machine guns but can be altered to include 20 or 23 mm. automatic cannon. Other details of equipment and construction are shown. *Aviation*, July 1941, page 61, 2 illus.

Dos Parientes (Two of a Kind). While the Lockheed P-38 was being brought out in the United States, Germany created the Focke Wulf Fw 189. Both pursuit airplanes are compared in this article. The Fw 189 is said to have a speed of 650 km. per hour as compared to the 690 km. per hour speed of the P-38. Both craft are equipped with machine guns and cannons according to experience gathered during the present war. *Aeronautica*, June 1941, page 41, 2 illus.

CallAir Model A. Specifications of a semi-cantilever, low-wing cabin-airplane for the private flyer. Powered with a Continental 80 hp. engine, cruising speed is said to be 101 m.p.h. with a range of 500 miles. Equipment includes standard instruments, landing flap, parking brake, radio shielding and antenna. *Aviation*, July 1941, page 62, 3 illus.

Fighter Philosophy. Lawrence D. Bell. The President and General Manager of Bell Aircraft Corp. discusses the philosophy behind the design of the Bell Airacobra. Going back to fundamentals of firepower, mobility and speed, he explains that the Airacobra was designed to cope with Panzer divisions and mosquito fleets, and to successfully attack large, heavily armed bombers. Improved landing characteristics and greater vision and ease of handling were believed to be greatly needed in military fighters and he describes how these qualities were built into the Airacobra. Resulting problems of aircraft and armament design are also discussed. *Aviation*, July 1941, pages 74, 75, 90, 98, 3 illus.

Northrop N-3 Patrol Bomber. Description and performance data for a new three-place patrol bomber. The Northrop N-3 is a single-engine, low-wing, cantilever monoplane carrying 6 machine guns and 2,000 lbs. of bombs or a torpedo. Powered by a Wright Cyclone 1,200 hp. engine, it has a maximum speed of 228 m.p.h. and a surface ceiling of 24,000 ft. *Commercial Aviation*, June 1941, pages 48, 50, 1 illus.

Skyfarer. Illustrated story of the General Aircraft Corporation's two-place, two-control airplane. Designed by Dr. Otto C. Koppen, of the Massachusetts Institute of Technology, the Skyfarer is powered by a geared Lycoming 75 hp. engine, carries 20 gallons of gas in wing tanks, and is equipped with a tricycle landing gear. Cruising speed is 90 m.p.h. *The Sportsman Pilot*, June 15, 1941, pages 22, 23, 43, 44, 4 illus. Also *Air Facts*, July 1941, pages 14–23, 4 illus.

Notes on the VS-300. Further details regarding Igor Sikorsky's helicopter. It is stated that a military version of this aircraft is now under construction at Stratford, Connecticut, for the U.S. Army Air Corps. *The Sportsman Pilot*, June 15, 1941, pages 10, 11, 48, 3 illus.

Amatoren Spekulerar over det medeltunga bombplanet-fjarrspaningsplanet (Speculations of an Amateur on a Medium Weight Long-Distance Bomber). The writer compares the characteristics of the Dornier Do 215, Bristol Blenheim, Martin 167 and the Ju 88. Deductions are drawn for the design of an "ideal airplane" which the writer suggests should have the following characteristics: Span, about 17 m.; length, 14 m.; wing area, 46.5 m.^{2}; flying weight, about 6,000 kg.; bomb load, 1,000 kg.; maximum speed, 550 km. per hour; and cruising range about 3,000 km. *Flygtidningen*, March 1941, page 10, 2 illus.

Owlet. A description of the Owlet airplane of the General Aircraft Ltd., in England. The airplane was built for civil use but has been converted by the R.A.F. for use as a training airplane. The conversion is described. *Flygning*, April 1941, page 11, 4 illus.

Sjoflygplanet Som Privatplan (Seaplanes as Private Airplanes). A description of the use of seaplanes as towing planes in the United States. Characteristics of many of the new airports which make servicing easy are pointed out. *Flygning*, April 1941, pages 10, 22, 2 illus.

Air Law

If You Were an Airline President. Geoffrey Gordon. Explanation of the legal steps preceding the establishment of a new airline route. *Flying and Popular Aviation*, July 1941, pages 42, 43, 92, 94, 2 illus.

Air Photos Forbidden. George R. Reiss. Private flyers are cautioned against flying over or photographing military reservations, mine fields, naval bases, naval vessels, arsenals, and factories manufacturing equipment for national defense. According to President Roosevelt's executive order of March 22, 1940, such violations carry a fine up to $1,000, or imprisonment up to one year, or both, for photographing and, in some cases, flying over such defense sectors. *Flying and Popular Aviation*, July 1941, pages 21, 80, 81, 1 illus.

Air Policy

Britain Calling. Brief review of British war effort during the first half of 1941, with a discussion of lessons to be gained from these developments.

The writer recalls that 1941 was forecast as the year of setbacks and suggests a redoubled effort to make 1942 more successful. The evacuation of Crete is pointed out as a triumph of air power. Mention is also made of several new fighters which are now in quantity production. *Commercial Aviation*, June 1941, pages 42, 44, 1 illus.

Aviation's Unlimited Emergency. Selig Altschul. The effect of President Roosevelt's proclamation of an unlimited emergency upon the aircraft industry is discussed. The strike settlement at North American Aviation, Inc., and the Government's plan for expanded production of heavy bombers are noted. Boeing production of heavy bombers is said to have been delayed by as much as 90 days due to the late delivery of aluminum allotments. The writer believes that expansion of aircraft production will probably not be able to maintain its present rate of increase due to shortages of skilled labor and raw materials. T.W.A.'s order for 40 of the new Lockheed 64-passenger transports and the possibilities of this new transport in commercial aviation are touched on briefly. *Aviation*, July 1941, pages 53, 148.

Air Power and Sea Power, Again. Cy Caldwell. Discussion of the reasons why the United States should have a separate Air Force. The writer points to lessons of the present war and what he considers mounting evidence that airpower alone can be a decisive factor in either land or sea operations. He also suggests a unified command over the separate and equal forces of the Army, Navy and Air Force. *Aero Digest*, July 1941, pages 53, 55, 241, 242, 4 illus.

Yes—We Must Air-Condition America. Robert H. Hinckley. The head of the C.A.A. outlines the accomplishments of the Civilian Pilot Training Program and suggests a program for its continuation. It is stated that the C.P.T.P. is now turning out private pilots at the rate of 3,000 a month, while the advanced course is being given to the pick of the private pilots at the rate of 1,000 a month. According to the writer there are 945 training centers operating today, more than 200 of which are in the non-college phase of the program.

It is suggested that in the future training might well begin in elementary schools among the 2,000,000 youngsters working with models. In high schools they would progress to constructing elementary gliders and learn to fly them. Training in power flight would be retained in the colleges and for special non-college groups. The writer believes that after the war aviation can become the new industrial frontier we have needed for the past decade. Possibilities in air line expansion, air freight, and the carrying of all first class mail by air are also mentioned. *Liberty*, June 28, 1941, pages 14, 15, 41, 1 illus.

Airports

Presidente Rivadavia Airport. P. B. Padilla and E. T. G. Palmer. The Chief Engineer of the Argentine Civil Aeronautics Authority and an official of the Compania Standard Electric Argentina, give details of lighting equipment of the Presidente Rivadavia Airport. It is stated that South America is giving serious consideration to expansion of its night flying facilities and equipment, especially as its commercial airlines are being extended to bring modern transportation to more thinly populated areas. Airport beacons, field lighting and control equipment are described. *Aero Digest*, July 1941, pages 65, 66, 234, 5 illus.

Dogs and "Cats" Help Carve Out Canada's New Far-North Airfields. Caterpillar tractor trains are following trails blazed by dog teams to freight in heavy equipment needed for airport construction at Fort Nelson, British Columbia. It is said that material and heavy equipment have had to be freighted 300 miles from the rail head to build this airfield, one of a chain for hemisphere defense. *Commercial Aviation*, June 1941, page 50, 2 illus.

Wake en Midway (The Wake and Midway Islands). Eric Janssen. A correspondent of *Vliegwereld* who recently returned to Dutch East India from America *via* Pan American Airways reports his impressions of the air bases on these islands. *Vliegwereld*, May 22, 1941, pages 256–259, 5 illus.

Thunderbird of Arizona. Lewin B. Barringer. An inspection-tour sketch of Thunderbird Field, twelve miles northwest of Phoenix, Arizona. It is the newest of the primary training bases for the rapidly expanding Air Corps. Its buildings, facilities and equipment are described with notes on the men who developed the field and are now conducting its operations. *U.S. Air Services*, June 1941, pages 24, 26, 1 illus.

When Warbirds Roost. James Ellis. Discussion of the United States' present need for military air bases. It is said that plans have been completed for a long-range $600,000,000 airport program. Also mentioned is the fact that out of 2,655 airports, fields, and seaplane bases in the U.S., only 31 are suitable for operations involving our latest types of military aircraft. Considerations which govern the choice of sites for military air fields are outlined together with the problems and approximate costs of construction. *Flying and Popular Aviation*, July 1941, pages 36, 37, 64, 66, 3 illus.

Wireless Light for Seaplane Bases. Michael Lorant. Description of the development of wireless control for "contact" lights mounted in a floating unit not hazardous to navigation. Wireless receivers in the mounting controlled by a short-wave shore station turn the lights on and off as needed for the guidance of seaplanes making night landings. The system was evolved jointly by Westinghouse and Firestone engineers working in cooperation with the C.A.A. *The Aeroplane*, May 23, 1941, page 580, 2 illus.

Air Power

Ten Air Power Lessons for America. Alexander P. de Seversky. A summary of the chief aviation lessons of the present war to date. The writer concludes that many of these were foreseen and foretold by advocates of Air Power, and that it has taken the experience of actual warfare to demonstrate them to skeptics. Stressing the need for a separate air force, the writer contends that activities of military aviation should be concentrated into a single department and directed by aviation experts. *Flying and Popular Aviation*, July 1941, pages 14, 15, 62, 78, 79, 2 illus.

Mighty "Winged Army" the Goal for America. Maj. Frank L. Nelson. A brief view of American facilities for developing a "winged army" in line with recent parachute troop activities in the current World War and in anticipation of possible future demands on American military forces.

The ideal winged army is treated as a group of several divisions of airborne infantry carried in huge transports and towed gliders. Each division would be supported by its own aviation units, consisting of pursuit, observation and bombing planes; airborne artillery and tanks; and airborne supply and ammunition trains.

The elements of Germany's successful parachute troop participation in the taking of Crete are examined. The actual development of winged-army potentialities in this country is found to be short of requirements. Recent rulings of the War Department made a permanent institution of the parachute school at Fort Benning and provided for the establishment of a parachute reserve by using selective service trainees to comprise 20

per cent of the parachute troops to be trained. However, manufacture of transport aircraft is being largely sacrificed to the production of bombers and fighters, and legislative moves toward subsidized glider schools have met with little success. *U.S. Air Services*, July 1941, pages 12–15, 3 illus.

Was uns der Luftkrieg 1939/41 lehrt (Lessons of the Aerial War 1939–41). Capt. Ernst Wyss. A review of the part played by air forces in the present war. The writer refers to Douhet's modern war theory with which he agrees. According to this theory, it is useless to search history for precedents applicable in modern war. The development of the present war to date, he says, has fully supported this theory.

The "lessons" of the current war are pointed out. These are to be found in the growth of air forces from an auxiliary and scouting arm in 1914 into a main part of the armies and navies of 1941; the ability of the air arm to carry on a war blow by blow; the elimination of fronts by air attacks at distances far behind the actual fighting front; the strategic advantage of an air arm as such.

The air arm—unless it operates on an independent mission—is a part of the entire fighting forces. The air arm's potentialities enhance the strength of both army and navy, which today fight in closest cooperation with the air arm. However, the writer believes that the final decision will not be reached by the air arm; the soldier in the long run will win or lose the war. This truth, thousands of years old, will prevail in this war also. *Schweizer Aero-Revue*, May 1941, pages 31, 32.

Aviacion Arma No. 1 (Aviation the Number 1 Arm). Notes on the effectiveness of air power in the present war. The attack of the R.A.F. against Italian men of war in the harbor of Tarento, its action during the sea battle of Cape Matapan and the operations of the German air force in the battle of Crete are analyzed briefly as conclusive evidence of air power's superiority over naval forces. *Aeronautica*, June 1941, page 43, 1 illus.

Kriget i Luften—III (Aerial Warfare—3). The third in a series of articles on aerial warfare and its decisive results in the present war. According to the writer, the German successes in the air are due to an independent air force and to the high-geared output of the German aeronautical industry. He reviews the tactics of the belligerents and describes the air attacks on both sides. *Flygtidningen*, March 1941, pages 3, 9.

Air Transport

The Rise and Fall of China's Airlines. Edward Churchill. Commercial transports in China now fly different routes, altitudes and schedules each time they make a run. While Japanese military aircraft have not been able to ground commercial flying in China, they have forced it to fly by night, and by day only in instrument weather. The writer describes several experiences of E. M. Allison, President of the Harlow Aircraft Company, in commercial flying during the war in China. *Flying and Popular Aviation*, July 1941, pages 44–46, 3 illus.

Reducing Stacking Delays. C. H. McIntosh. The instructor in charge of the Chicago pilot training school of American Airlines outlines what is being done in Chicago and New York to lessen the time interval between instrument approaches of commercial transports.

Under instrument conditions, transports "stack up" at different altitudes awaiting their turn to make an instrument approach. Under the present system, such an approach takes about 12 minutes per airplane. The condition is further aggravated in that each circling transport must locate itself in relation to the approach beam before it can begin the descent. Also until now the range control operator has had to relay instructions to the traffic control tower for transmission to pilots, thereby losing time and running risk of error in instructions.

Methods are being developed at New York and Chicago for what is termed straight-in descent. Radio position markers far enough away from the airport to permit a safe stepping-down of altitude are being combined with direct communications between the range control operator and pilots. The systems and procedure at New York and Chicago are described in detail. *Aviation*, July 1941, pages 40, 41, 156, 158, 176, 6 illus.

Catalina Flies Ocean Without Its Ailerons. An account of the ferrying of a Consolidated patrol bomber from Bermuda to England, flying part of the way without ailerons. About six hours out from England, both ailerons were lost at an altitude of 18,000 ft. Spinning down, the aircraft recovered at 400 ft. and finished the flight minus aileron control. A description is given of the method of control worked out by the pilots for the remainder of the flight. *Canadian Aviation*, June 1941, pages 38, 42, 2 illus.

I Meet Baldy. A Co-Pilot. A realistic account of a hazardous experience which is said to have become history among the Atlantic ferry pilots. The trying adventure occurred when a ferry pilot was obliged to make an emergency return to his base with a dead engine. *Air Trails*, July 1941, pages 25, 53, 54, 1 illus.

Air Express. . . and Where It's Going. C. G. Peterson. Details of operation, costs, and volume figures and statistics on shipments by Air Express. Rates are discussed together with reasons for fluctuations in air cargo traffic. Air Express commodity groupings are also shown. *Aviation*, July 1941, pages 32, 33, 152, 154, 3 illus.

Trafikflyget Och Det Nationella Forsvaret (Transport Flying and National Defense). Excerpts reproduced from an address by T. B. Wilson, chairman of Transcontinental & Western Air, on the relationship of commercial air lines to the national defense program and the effects of each upon the other. *Flygning*, April 1941, pages 12, 22, 2 illus.

Luchtvaart in de Philippignen (Commercial Aviation in the Philippine Islands). Up to 1939 there were two air lines in the Philippine Islands, the Philippine Aerial Taxi Company and the Iloilo Negros Air Express. The first went out of business leaving the latter line alone in the field. Recently a new line has been established—the Philippine Airways which provides good service and will serve a feeder line K.N.I.L.M. at Manila. *Vliegwereld*, May 29, 1941, page 272, 2 illus.

Avigation

Maps for Long-Distance Flights. Bradley Jones. A brief discussion of the corrections that must be made on various types of maps used in long-distance flights. Various map projections incur distortions at different points with the result that a line of flight marked out on the map must take into account the variations pertinent to the map used. *U.S. Air Services*, June 1941, pages 16–18, 2 illus.

Fly by the Stars. William W. Ehmer. An introduction to the study of celestial navigation for the private and commercial pilot. The writer believes that if war were suddenly to black out our radio aids to navigation, we would have to use a combination

of dead reckoning and celestial observation, as is now done in Europe. The significance of the position of celestial bodies, the sextant sight, timing the sight, and figuring line of position, are explained simply and briefly. Practice methods and necessary equipment are also described. *Flying and Popular Aviation*, July 1941, pages 30–32, 4 illus.

Air Lighthouses. William M. Stair and Robert L. Lewis. An account of the care and maintenance of airway beacons, and of the caretakers who keep them in operation. *Flying and Popular Aviation*, July 1941, pages 38, 39, 40, 96, 3 illus.

Riding the Range to New York. An account of procedure used in flying radio ranges in instrument weather from Toronto to New York. The writer, aboard a Trans-Canada Air Lines transport, reports radio communications and terminology used during the flight. Details of the flight plan, flight clearance at Toronto and at control centers enroute, as well as the let-down procedure at La Guardia, are described. *Canadian Aviation*, June 1941, pages 37, 49, 1 illus.

Use of Radio in Aviation. Assen Jordanoff. An introduction to radio range flying and orientation. Types of transmitters used are discussed together with beam patterns, the cone of silence, multiple and bent beams, and the 90°-turn method of orientation when approaching a range station. *Canadian Aviation*, June 1941, pages 39–42, 13 illus.

Magnetic Declination. Warren C. Youngclaus. An explanation of magnetic variation, what it is and why it is of vital importance to the navigator. An isogonic chart of the world is shown, and the yearly change in variation, or magnetic declination as the writer terms it, is discussed. *Aero Digest*, July 1941, pages 61, 62, 4 illus.

Astronomical Avigation. Frederick Harrison Tregenza. The sixth in a series on celestial navigation of aircraft. The writer describes the theory, construction, use and potential errors of the aircraft bubble sextant. *Commercial Aviation*, June 1941, pages 26, 28, 54, 3 illus.

Eenvoudige Navigatie ten dienste van de Sportvliegers (Simple Navigation for Sport Fliers). J. W. Verhoeven. The third of a series of articles describing various types of compasses. *Luchtvaart*, May 20, 1941, pages 196–198, 3 illus.

Design

Aviation Sketch Book of Design Detail. A series of cut-away drawings and captions showing design details of current military, commercial and private aircraft. Among these are the new Luscombe exhaust manifold system, engine installation of a Heinkel He 111 and under-fuselage machine gun mount of the Northrop N-3 Patrol Bomber; the center section truss and a wing panel frame used on the twin-engined Beechcraft. Also included are the engine installation in the Rearwin Cloudster and the new Ryan PT-21, and the Madsen gun installation in the Curtiss Hawk 75 export version. *Aviation*, July 1941, pages 64, 67, 11 illus.

Weight Economy. John E. Ayers. An outline of methods of weight control. The writer offers a check list of questions, such as whether aluminum alloy can be substituted for steel, and discusses each in turn. These concern substitution, simplification, structural forms, types of fittings, etc. Suggestions and information about new methods and materials are also included. *Aero Digest*, July 1941, pages 138, 140, 142, 238, 241, 7 illus.

Problems of Weight Control. L. R. Hackney. Discussion of the functions of the weight control engineer. The writer states that weight has been found to be a reliable factor in determining costs. The cost-per-pound can be estimated very closely. Problems of designing weight out of aircraft are discussed, and some interesting figures given on the potential value-per-pound of aircraft to both manufacturer and air line. *Aero Digest*, July 1941, pages 134, 136, 237.

We Built the Giant Killer. Robert J. Woods. An interesting account of the design and production of the Bell Airacobra prototype. According to the writer, who is chief design engineer of Bell Aircraft Corp., the Airacobra was designed and built around an automatic, rapid-fire 37-mm. aircraft cannon. First designs placed the pilot behind the engine-cannon unit, but later this was changed to the present arrangement, although it meant designing a 10-ft. extension drive shaft. The longest extension drives of this type up to then were only 5 ft. Elimination of mechanical and design problems as they developed is described together with several of the many tests which had to be met and passed by the prototype before the production model could be put into quantity production. *Air Trails*, July 1941, pages 12, 13, 46, 48, 49, 5 illus.

Engines

Design Features and Performance Characteristics of the Mercedes-Benz DB-601 A Aircraft Engine. A summary of the first part of the S.A.E. aircraft engine section's summer meeting, at which a paper on this subject was read by Raymond W. Young of Wright Aeronautical Corp. The major part of this paper consisted of a teardown inspection of the engine with detailed descriptions and comments on the design features of major component parts, followed by a check of the magnaflux inspection method, analysis and comparison of materials and comparison on quality of finish.

The engine dissected at the meeting revealed technical details of such features as automatic mixture control, solid fuel injection and fluid supercharger drive. The paper reviewed the development of the engine, quoted specifications and compared the physical and performance characteristics of the engine with contemporary American, British, French and German power plants of the same general design. This report includes a summary of the discussion which followed the reading of the paper. *S.A.E. Journal*, July 1941, pages 22, 23.

Motores Jumo 205 y 207 (The Junkers Jumo 205 and 207 Aircraft Engines). Detailed description of these Diesel engines includes specification and performance figures. *Aeronautica*, June 1941, pages 19, 38, 1 illus.

Heat Transfer in Geometrically Similar Cylinders. P. Riekert and A. Held. A discussion of the power-stress and heat-stress conditions of geometrically similar engines. The advantages accruing from smaller cylinder dimensions are found to be higher specific horsepower, lower weight per horsepower, lower piston temperature and less frontal area, with reduced detonation tendency. *N.A.C.A. Technical Memorandum*, No. 977, May 1941, pages 1–11, 2 illus.

Dynamic Similitude in Internal-Combustion Engines. O. Lutz. This report suggests a method for comparing the dynamic similitude in various types of internal-combustion engines. In general form it is on the basis of similarity considerations, which obviates the assumption of constant piston speed. It is shown that the piston speed or any other speed, such as bearing velocity, must be independent of the quantity dimensions and must be a representative quantity similar to the high speed

and the specific weight per horsepower. *N.A.C.A. Technical Memorandum*, No. 978, May 1941, pages 1–17, 2 illus.

Larger Franklin Engines Developed. Paul H. Wilkinson. Performance details and specifications of the new Franklin horizontally opposed, air-cooled eight and twelve-cylinder aircraft engines. The new engines use the same type cylinder as is used in the smaller Franklin four and six-cylinder engines, with many parts interchangeable. The eight-cylinder engine is rated at 200 hp. at 2,600 r.p.m.; the twelve-cylinder engine is rated at 300 hp. at the same r.p.m. Details of carburetion, lubrication and accessories are described together with points of design and construction. *Aviation*, July 1941, pages 57, 150, 2 illus.

Engines From Line Production. A description of the new Lockland, Ohio, plant of the Wright Aeronautical Corporation. The new unit, which covers 2,120,000 square feet of floor space will turn out one thousand 1,700-hp. engines a month. Details of the plant layout, equipment, and assembly sequence are given. *Aviation*, July 1941, pages 54, 55, 5 illus.

Modern Aircraft Valves. A. T. Colwell. Part 3 of a survey of the development of American and European aircraft engine valves. Nitrided valve stems, sodium-cooled valves, cleaning valve heads, and prevention of valve failure, are discussed. *Commercial Aviation*, June 1941, pages 19–22, 54, 17 illus.

Engines Tested Without Noise. Description of new test cells and equipment at the Montreal Plant of the Wright Aeronautical Corporation. It is stated that much has been done to eliminate noise from the test cells by the use of sound-muffling stacks in addition to regular sound-proofing. *Commercial Aviation*, June 1941, page 46, 5 illus.

Standardization of Aircraft-Engine Components. Gustaf Carvelli. Standardization of engine components should start in the drafting room with the use of a system of sample drawings according to this writer, who also believes that dimensioning of parts should be simplified through use of a two-place decimal system.

The importance of standardization of notes, clearances, tolerances and other data listed on drawings is emphasized. Further, threaded parts, gear tooth form and many such items can and should be standardized, serious consideration being given to adoption of the metric system.

Since the Army-Navy (AN) Standards were developed primarily for airplanes and often do not apply to aircraft engines, it is suggested that a new set of standards must be developed for parts used on engines only. *S.A.E. Journal*, July 1941, pages 294–300, 11 illus.

Skottskador Pa Luftkylda Flygmotorer (Damages Caused by Projectiles on Air-Cooled Aircraft Engines). Edvin Bjornsjo. A review of a report by K. Kress, published in Luftwissen, vol. 7, no. 12.

Investigations on two engine types, the Bramo 323 and the BMW 132, revealed that air-cooled engines, even though severely damaged by bullets, are not put out of commission as long as the lubrication system remains intact. In most cases, the airplanes were able to return to their bases.

This article is accompanied by many illustrations showing the various engine parts hit by projectiles. *Flyg och Motor* (*Technical Supplement*), *Flygning*, April 1941, pages I–III, 15 illus.

Combustion Gas Turbine Design. J. T. Rettaliata. Summary of a paper delivered at the summer meeting of the S.A.E. aircraft engine section. Present-day gas turbine thermal efficiencies for a non-regenerative cycle are between 16 and 17 per cent with a turbine inlet temperature of 1,000°F., the highest operating temperature possible for the materials employed. With a regenerative cycle employing a heat exchanger to preheat, the compressor discharge air with the turbine exhaust gas, the thermal efficiency of a unit may be increased approximately 50 per cent over the above figures.

Because of the temperature limitations of the materials, real incentives exist for the development of materials capable of withstanding operation at higher temperatures. Laboratory metallurgical investigations now in progress indicate that continuous operation at 1,500°F. is within the realm of possibility. At such temperatures, the thermal efficiency of a regenerative gas turbine cycle approaches the Diesel range and results in reduced unit cost and weight.

The cycle of the gas turbine is said to be particularly attractive for installations lacking water facilities, and it is toward the proper, natural and favorable application of the gas turbine that present development is being directed. The discussion following this paper is included with this summary. *S.A.E. Journal*, July 1941, pages 27, 28.

Flight Testing

Test Flying a Ball of Fire. Brian Sparks. The chief test pilot of Bell Aircraft Corp. analyzes some of the flight test problems which attended the testing of a high-speed fighter of radical design. He writes that in testing a 400 m.p.h. airplane, an obvious source of error is the effect of compressibility on air speed measurements, amounting to as much as 7 per cent at 400 m.p.h. Details of climb tests, stability tests, air loads on flaps and landing gear, structural effects of compressibility, effects of center of gravity shifts as well as engine-cooling tests are described. *Aviation*, July 1941, pages 84, 85, 96, 98, 6 illus.

First Test Flight. J. L. Rees. A description of the test flight of a new fighter, written by an R.A.F. flight lieutenant who was later killed in action. While no technical details are given, preparations for the flight, several flight maneuvers, and an unsuccessful test spin in which the pilot is forced to bail out are described. *Canadian Aviation*, June 1941, pages 36, 44, 49, 1 illus.

Fuels and Lubricants

Wat is Octaan (What is Octane)? H. J. C. Pfeiffer. A study of fuels and their anti-knock properties. Compression ratio, anti-knock compounds, the determination of anti-knock strength and octane numbers are discussed. The article is one in regular series captioned *Theory and Practice*. *Vliegwereld*, May 29, 1941, pages 276, 277, 2 illus.

New High-Altitude Fuel System for Aircraft. W. H. Curtis and R. R. Curtis. Opening with a review of the work done in the past on aircraft fuel systems to adopt them for high-altitude flight, this paper discusses the reasons for failures that developed, considers some of the physical aspects of aircraft fuel at high altitude and furnishes a brief description of the Thompson booster system.

The discussion of the physical behavior of aviation fuel at high altitude is based on observations made during many laboratory tests. Observed behavior of fuel systems in laboratory altitude simulations is described. Differences between this and apparent behavior during actual flight are explained. It is pointed out that due to these differences no direct correlation between laboratory simulations and actual flight performance can be made at present. Until this handicap can be overcome, prediction of fuel-system performances must be based upon comparison between simulation tests some of which are simulations of satisfactory fuel systems.

The Thompson Booster system was evolved as the result of the application of analytical reasoning to the fuel systems that preceded it. The booster unit is a modified centrifugal pump, attached directly to the fuel tank and driven by an electric motor. Its function is to prevent entrance of

released vapor and air to the fuel line leading to the fuel pump on the engine. It also maintains sufficient pressure in this line to prevent additional release of air or vapor. *S.A.E. Journal*, July 1941, pages 260–265, 10 illus.

Light Airplane Engines and Their Fuel Problems. Summary of a session on this subject at the summer meeting of the S.A.E. aircraft engine section. A paper presented by Carl T. Doman, of Aircooled Motors Corp., pointed out that light airplane engine makers recently have been faced with the problem of the entire rearrangement of the fuel situation based on the national emergency. Fuels of 65, 73, 91 and 100 octane number will be used eventually, eliminating those of 80, 87 and 95 octane number.

Due to drastic increases in the lead content of fuels as a result of this revision, the light airplane engine designer faces a serious problem where customers are demanding increased power at no increase in cost or weight. The effects of using greater proportions of lead and the attempts to alter the engine design to permit the use of higher leaded fuels without seriously increasing the weight or cost of the engines were pointed out.

The use of dual carburetion on a 6-cylinder opposed type of engine was held to be the simplest solution for the present. It was emphasized, however, that the designer of the light airplane must better appreciate the necessity of improved cooling and pay more attention to details in the installation as his part in obtaining the maximum efficiency from the engine.

The principal objection to the use of automotive fuels was said to be in the possibility of vapor lock and indefinite knock rating. At present there are no gasoline aircraft engines in this country approved for use of a fuel other than aviation grade. The discussion following this paper is included in this summary. *S.A.E. Journal*, July 1941, pages 23–27.

Combustibles Sinteticos en Aviacion (Synthetic Fuels in Aviation). An article on hydrogenization of cracked gasoline which produces a high grade anti-knock gasoline. The entire process is described. *Aeronautica*, June 1941, page 31.

Synthetic Chemicals in Fuels and Lubricants. W. G. Whitman. Digest of a paper presented before the National Industrial Chemical Conference at Chicago. This discussion of synthetic chemicals which are being reclaimed as "reaction products" from modern refining processes includes a description of some of the synthetic octanes which are being added to high-octane aviation gasoline. *Industrial and Engineering Chemistry*, July 1941, pages 865–868, 2 illus.

Gliding and Soaring

Time in Sail. Wolfgang Langewiesche. The first of two articles on the writer's experiences in gliding and soaring at Elmira, New York. *Air Facts*, July 1941, pages 24–44, 5 illus.

An Introduction to Soaring. Robert M. Stanley. Part 4 of a series on gliding and soaring. Included is a description of an altitude flight in the core of a thunderhead, in which rates of climb in excess of 4,000 feet per minute have been registered. It is stated that turbulence has imposed gust acceleration loads of more than 8g on sailplanes flown by expert pilots. Primary training sequence, towing equipment, and contests are also discussed. *Soaring*, March-April 1941, pages 8–10.

Annual West Coast Contest. Account of the Western Championship Contest held at Arvin, California. Outstanding flight of the meet was that of Henry Stiglmeir in which he probably shattered the American altitude record. Unfortunately the stylus went off his barograph drum at 19,150 feet long before he had reached maximum altitude, and his corrected altitude of 16,400 feet fell short of the record. Other events and point winners are given. *Soaring*, March-April 1941, pages 6, 7, 3 illus.

A Worthwhile Suggestion. Robert Eikenberry. It is suggested that a program of training in gliding and soaring be included in the Civilian Pilot Training Program. The writer states that advantages of glider training lie chiefly in practicability for training of younger boys. He believes that difference in cost is not as great as commonly supposed, while many more hours of powered flight training can be had in a shorter space of time. Nevertheless, he feels that there is a distinct place for glider training in the CPTP for boys from 15 to 18 years of age, and suggests that it be done through private operators, as CPTP does with power flight contracts. *Soaring*, March-April 1941, pages 4, 5.

Start von Segelflugzeugen (Launching of Gliders). R. Kassowitz. Of the many methods of launching a glider, that of airplane towing is said to be the most practical for level ground. This article effects to prove by mathematical demonstration that airplane and glider must have similar flight characteristics to bring about a successful launching. At a certain static pressure, it is possible to calculate the resistance of each of the two machines from the airplane curves, and to estimate the propeller advance in function of flying speed and the performance as a parameter. *Schweizer Aero-Revue*, May 1941, pages 12–14, 5 illus.

Blind Flying in Icing Conditions. John Robinson. Account of a glider flight which won the meet trophy for altitude over flat country, at the American Open Soaring Contest held at Lockport, Illinois. Flying a Schweizer all-metal sailplane the writer attained 14,000 ft. soaring on instruments in an occluded cold front during severe icing conditions. After a flight of 2½ hours he landed 72 miles from Lockport. Soaring through hail, and the effect of two inches of rime ice on and under the leading edges of wings and tail surfaces, are described. *Soaring*, March-April 1941, pages 3, 5.

Record Flights. Alexis Dawydoff. Details and particulars of record glider flights on which attempts will be made at the Twelfth National Soaring Contest. Included are accounts of record flights for altitude, distance, distance and return, and duration. *Air Trails*, July 1941, pages 24, 51, 52, 7 illus.

Pilots, Pilots, More Pilots. Commander E. F. McDonald, Jr. The case for the glider in the mass production of pilots is again presented. Advantages are said to be not only low cost and greatly increased numbers of students, but also the excellent training in aerodynamics, air currents, meteorology and flying judgment to be had in gliding and soaring. The training sequence is also outlined. *Scientific American*, July 1941, pages 20–23, 3 illus.

High-Altitude Flying

The Use of Liquid Oxygen for High-Altitude Flying. John D. Akerman. Description of a method and apparatus for producing gaseous oxygen for use in high-altitude flying, from liquid oxygen. The elimination of the danger of discontinuity of oxygen boiling and the provision for securing the required volume of oxygen gas are accomplished by keeping the liquid oxygen under a predetermined pressure and supplementing the normal evaporation by spilling a necessary amount of liquid oxygen in the gas contained. Fast evaporation takes place to maintain a constant supply of oxygen gas inside the apparatus which is connected with a second-stage reducing valve of a B-L-B oxygen mask as developed by the Mayo Foundation.

To secure the spilling of liquid oxygen into the gas container, an absolute pressure valve is provided in the gas contained to keep a predetermined

pressure of gas in the liquid container. The liquid container does not require the use of a vacuum bottle. Although no attempt is made to design the apparatus for any specific airplane, the mechanism is flexible for adaptation to meet any specific requirements of oxygen supply. Apparatus for handling and storing liquid oxygen and the possibilities of a portable liquid oxygen producing plant are discussed. *Journal of the Aeronautical Sciences*, July 1941, pages 361–364, 8 illus.

High Altitude Flying. Bruce Foster. A review of problems and developments in military and commercial high-altitude flight. The writer discusses physical problems, the effect of altitude on pilots, pilot and crew conditioning, as well as mechanical problems of supercharged engines and pressure cabins. Experimental work being done in England and the United States is outlined, and a brief chronology of altitude record for both aircraft and balloon is given. *Flight*, June 5, 1941, pages a–e, 18 illus.

Stratosphere Conditioning. Description of the pressurized tanks and oxygen equipment used by the Boeing Aircraft Company to train and condition flight test crews for high-altitude work in Flying Fortress bombers. Air combat is taking place at constantly increasing altitudes, and the training and conditioning of crews for high-altitude flying is rapidly becoming a problem. The effects of high altitude on the human organism and procedure for conditioning crews prior to such flights, are also described. *Commercial Aviation*, June 1941, pages 32–34, 54, 6 illus.

Waarom naar de Stratosfeer (Why into the Stratosphere)? O. W. P. Mohr. The first of a series of articles in which the author goes into details on cosmic rays. To get more data on these rays it is necessary to search the stratosphere where investigations are more successful than at lower altitudes. Therefore, stratosphere flights have been made and will be made more extensively in the future. A table shows altitudes attained by man and balloons to date. *Luchtvaart*, May 20, 1941, pages 189, 190.

History

The R.A.F. 1914–1940—an Historical Record. J. M. Spaight. A brief review of the fluctuating strength and activity of the Royal Air Force since its inception in 1918. The sharp dwindling of its forces immediately after the last World War led in 1923 to a plan for its increase to a "sufficient strength adequately to protect us against attack by the strongest airforce within striking distance of this country." It is said that the program was still far from completion ten years after its adoption.

In 1934, Germany's withdrawal from the Disarmament Conference and her opening campaign to rearm led to a revision to strengthen the 1923 R.A.F. program; the chase which followed in the next four years left Germany at the top in air power. However, the further measures taken by Britain after the war began helped to bridge the gap and to do so at an earlier date than had been expected. The inauguration of the shadow factory scheme of aircraft production on the one hand, and on the other the formation of the Royal Air Force Volunteer Reserve helped materially to strengthen Britain's position. The article ends with a note on the superiority of British pilots over those of Germany as demonstrated during the current war. *Indian Aviation*, February 1941, pages 34–36.

Historia de la Aviacion (History of Aviation). Another in the series of articles treating of the development of military aeronautics during the World War up to April 1917. *Aeronautica*, June 1941, pages 22, 23, 37, 1 illus.

The Development of All-Metal Aircraft. F. Beach. Two articles in this extensive series deal with a review of the rôle played by Vickers Armstrongs, Ltd. The first carries the story up to the development of the "Wellesley" and "Wellington" aircraft, which are of the Vickers-Wallis patented geodetic construction. The second deals with the work of producing these latter models. *Sheet Metal Industries*, January and March 1941, pages 66–68, 8 illus.; pages 372–375, 12 illus.

The 25th Anniversary of Boeing Aircraft Co. An historical outline of one of the oldest aircraft companies in the United States. It is said that the present Boeing organization had its beginnings in a small hangar as a sportsman's hobby, in 1916. Since then the Company has produced 2,100 airplanes of 100 different types. Many of these are described in a chronology of Boeing production. *Aero Digest*, July 1941, pages 73, 74, 77, 78, 35 illus.

Boeing Celebrates 25 Years of Sterling Achievement. A highlight account of the events and personalities that have marked the development and expansion of the company now manufacturing Flying Fortresses—the Boeing Aircraft Company, which this Summer rounds out its first quarter century in the aviation industry. *U.S. Air Services*, July 1941, pages 16–19, 38, 3 illus.

Instruction

Fighter Pilots in the Making. The training of fighter pilots in England today is a far more extensive and regimented business than ever before, according to this résumé of the current training system. Formerly pilots qualified for their "Wings" at a flying training school and went straight to squadrons for their operational training. Today, at an Initial Training Wing, where the only airplanes are those whose flying days are over, the student learns the theory of flight, principles of air navigation, and the operation of controls, besides attending lectures on airframes, motors, guns, cameras and the weather.

From this course, pilots pass to an Elementary Flying Training School and learn to fly Miles Magisters or de Havilland Tiger Moths. If they are chosen for training as fighter pilots they graduate, at another school, on the more advanced Miles Master or North American Harvard, and gain their wings.

The gap between the advanced trainer and the Spitfire is even wider than that between the basic and the advanced trainers. Special schools, known as Operational Training Units, have been set up to help the student bridge this gap. As Hurricanes and Spitfires are single place craft, the student must fly alone. The specialized machinery of the Operational Training Unit removes the more troublesome hazards of this final stage. The problems encountered in this phase of pilot training, the devices used to simplify and expedite this stage and the routine of instruction are described. *The Aeroplane*, June 13, 1941, pages 648, 649, 3 illus.

Student Gets Job. E. N. Whittington. An executive of an aircraft production training school outlines necessary procedure in applying for a job in the Industry. Proof of citizenship, birth certificate, Social Security number, and other data which must be on hand before the job interview are listed together with suggestions for meeting important preliminary aptitude tests. *Air Trails*, July 1941, pages 18, 55, 1 illus.

How Fast the Turn? John R. Hoyt. The writer shows, both by

mathematical calculations and also by the use of a home-made accelerometer, that the degree of bank, not the speed, governs the elapsed time in a turn. Instructions are given for making a simple accelerometer from an inexpensive postage scale. *Flying and Popular Aviation*, July 1941, pages 47, 72, 76, 2 illus.

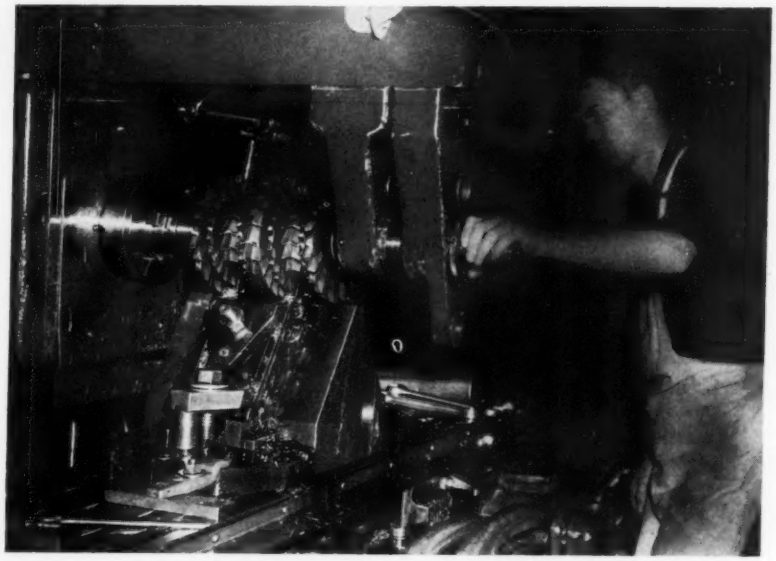
Tomorrow's R.A.F. Stanley Allen Trott. Description of the British Air Training Corps, organized to give training to boys between the ages of 16 and 18 so that they may become eligible for the R.A.F. The training is voluntary and lasts 10 weeks. It is noted that in less than six weeks after the formation of the ATC, 100,000 boys enlisted. *Air Youth Horizons*, June-July 1941, pages 3, 4, 1 illus.

Acrobatics Are Easy! Daniel J. Brimm, Jr. Part 3 of this series on acrobatic maneuvers includes descriptions of the half slow roll, the snap roll, the half snap roll or split S, half roll and reverse roll out, vertical reverse, and the Immelmann. Diagrams are shown for the Immelmann, vertical reverse, half slow roll, snap roll and half snap roll. *Aviation*, July 1941, pages 36, 37, 170, 172, 174, 176, 5 illus.

You Can Still Get It Free. Alexis Dawydoff. Further details of the Civilian Pilot Training Program, and suggestions for youth interested in free flight training. Stages of the flight course are described briefly, and the number of hours are given for both flight and ground courses. *Air Trails*, July 1941, pages 20, 60, 61, 2 illus.

Mechanics or Technicians? "Watchkeeper." This analysis of existing methods of training British aircraftsmen for the technical grades clarifies the distinction between a technician or mechanic and a technical man. The former has to learn theories and therefore must be taught, whereas the latter has to acquire his skill, which comes from experience.

However well-trained in theory the graduates of the Technical Training Schools may be, it is said, they are wanting in practical experience, without which they emanate from the schools virtually as raw as when they entered. It is suggested that whereas the course given in these schools involves about four months of technical training, all the theory a mechanic needs to know can be taught him in a month. He could then be posted to a squadron as a trainee to gain real experience. Such a plan would do away with the trades of flight riggers and flight mechanics, make trainees of all who do that class of work, graduating them to fitters by virtue of skill only. *The Aeroplane*, May 23, 1941, page 571, 3 illus.



One of the latest types of climb cut milling equipment, a Cincinnati hydromatic milling machine, used for milling landing gear parts for the P-40 and Tomahawk fighters at the Buffalo plant of the Curtiss-Wright Corporation.

Civil Pilots in Service Aircraft. The Aircraft Transport Auxiliary's organization, training and operations are outlined in this account of the movement which resulted from the plan of a group of British sportsmen pilots to supply civilian pilots for ferrying work and release R.A.F. service pilots for more important duties in combat squadrons. Some ten per cent of the flying strength of the A.T.A. is composed of women, and seven different nationalities are represented in the organization's personnel, whose duties are to ferry planes between factories, squadrons and repair stations all over England.

A.T.A. uses a variety of civil personnel: men who are unable to fly in the R.A.F. because of advanced years or some physical defect but are perfectly capable of flying airplanes; pilots who in peacetime were unable or had not the opportunity to take their "B" license; and some airline pilots, though an increasing number of these are being loaned to the Atlantic ferry service.

Pilots accepted for A.T.A. service must have an "A" license and a minimum of 50 hours. They receive a two weeks refresher course, consisting of lectures and from six to twelve hours of practice flying basic trainers. The student pilot then undertakes cross-country flights for navigation practice, and graduates to Harvard I's and battle trainers, ending this training stage by practice with Spitfires and Hurricanes. In the second course, the pilot is taught how to handle twin-engined types. Some pilots are then posted to Class 3, which deals with such types as the Stirling and Halifax four-engined bombers.

Some 81 different types of airplanes are included in the schedule of A.T.A. operations. The value of a pilot is assessed more by the number of types flown than the number of hours in his log book. The complicated scheduling system may take a pilot on a number of different deliveries on a circuit of various points before he returns to his base. When he leaves his base, he is given a loose-leaf folder with pertinent pointers on the particular characteristics of the various airplanes he is to fly before returning to base. *The Aeroplane*, June 13, 1941, page 650.

Instruments

Effect of Compass Location in Aircraft on Dynamic Errors. Walter Wrigley. An analysis of dynamic errors resulting from the aircraft compass being located off the center of gravity of the airplane.

A compass may be located, either for convenience or necessity, at some distance from the center of gravity of large modern aircraft. Such a location may give rise to dynamic errors in the readings of the compass due to the accelerations of roll, pitch and yaw of the airplane about its center of gravity. The acceleration of yaw is probably the most serious factor in producing such dynamic errors regardless of whether the compass is

located in the nose, the tail or in a wing.

The magnitude of the dynamic errors in compass readings increases in an approximately linear fashion as the distance of the compass from the center of gravity of the airplane is increased. For any particular location of the compass there will be a certain heading of the airplane for which the compass reading will have a maximum error. The dynamic errors may exist as magnitude effects of up to several degrees, or as phase effects of up to almost one hundred eighty degrees. *Journal of the Aeronautical Sciences*, July 1941, pages 365–367, 4 illus.

Materials

On the Problem of Materials for Tomorrow's Private Planes. John Stuart. A discussion of substitute materials for the light airplanes of the future. Wood and plastics, it is said, cannot be substituted for metal parts without extensive redesign and there remains much to be learned, both in research and in practice, before the general principles in the use of wood may be successfully applied. *The Sportsman Pilot*, June 15, 1941, pages 12, 42, 43, 5 illus.

Los Aceros Inoxidables (Stainless Steels). A study of commercial stainless steels, their composition, properties and application. *Aeronautica*, June 1941, pages 6, 7, 47, 4 illus.

Fatigue and Damping Studies of Aircraft Sheet Materials. R. M. Brick and Arthur Phillips. A report of investigations on Duralumin alloy 24ST, Alclad 24ST and several 18–8-type stainless steels. Specimens in the annealed, cold-rolled, stabilized and aged condition were fatigue-tested under constant deflection conditions. The S-N data obtained indicated the probable endurance limits, but were incomplete because of lack of time for aluminum alloys and the scatter of results for many of the stainless steels.

The ratio of endurance limit to tensile strength of the stainless steels was found to be relatively constant for one type of surface condition, but to change a maximum of from 30 to 70 per cent with different commercial finishes. Errors considered were mechanical or inherent in the test method; *i.e.*, increases of stress at constant deflection near the endurance limit accompanied by plastic behavior resulted from work hardening or decreases in apparent stress from crack formation and propagation, particularly in Alclad.

The effects of the two opposing factors, work hardening and cracking, were studied by means of damping and mechanical hysteresis (load-bending) tests on actual fatigue specimens at various intervals during stressing above and near the endurance limit. Very considerable changes took place in Alclad specimens, but changes in the stainless steels were relatively slight, although considerable differences were found among the various types studied. *Sheet Metal Industries*, April and May 1941, pages 511–516, 8 illus.; pages 635–638, 653, 10 illus.

Wood Comes Back. Ward Hill. The geodetic, all-wood method of air frame construction is explained in detail. Briefly, it consists of gluing spruce strips $^1/_2$ in. wide and $^1/_8$ in. thick in criss-crossing spirals from one end of the fuselage to the other. Each crossing joint is carefully glued with resin plastic glue.

The fuselage, which is elliptical or oval, contains longerons and plywood bulkhead rings at intervals. Wings and tail surfaces, which contain standard wood spars, are similarly covered with glued and cross-braced spruce strips.

The only metal used is in fittings, rotor mount and undercarriage. Such a monocoque geodetic structure is said to offer both resiliency and tremendous strength, the advantages being low cost, ease of construction and repair, and ample material supply. *Flying and Popular Aviation*, July 1941, pages 35, 84, 2 illus.

Alternate Materials and Design. G. F. Titterton. Suggestions for substitution of materials in aircraft design and manufacture. These include substitution of heat treatable aluminum alloys for the commoner alloys, substitution of gages, sizes and shapes, substitution of rolled stock for extruded stock or alteration of the latter to desired shape of the same gage stock. Also the use of steel and Monel for certain components. It is stated that work being done on complete components of plastic plywood may relieve the metal procurement problem considerably. *Aero Digest;* July 1941, pages 148, 241, 1 illus.

Medicine

"Atmospheric Chamber" for Flight Examinations. Maj. V. P. Flynn and Lieut. S. E. Flynn. The writers suggest the use of negative pressure chambers in physical examinations for Army and Navy flight training. Physical requirements of high-altitude flight and flight maneuvers in which changes of altitude and pressure are extremely rapid, as in dive-bombing, are said to be such that pressure tests similar to those given candidates for deep sea diving in the Navy might be designed for flight examinations.

The writers believe that such a chamber could be fitted with the essentials for regular flight examinations and possibly an apparatus similar to the Link Trainer to produce as nearly as possible all flight conditions and attitudes at different altitudes and atmospheric pressures. Advantages are said to be a saving in time, money and equipment, as well as a broadening of medical knowledge of the human organism under extreme flight conditions. *The Military Surgeon*, July 1941, pages 86–88.

Climate and Efficiency of Military Personnel. C. I. Singer. Discussion of the effect of climate and weather on military personnel, together with a plan for the systematic hardening and conditioning of troops to withstand sustained operations under any climatic conditions. *The Bulletin of the American Meterorological Society*, May 1941, pages 191–197, 1 illus.

Metallurgy

Continuous Normalising of Strip. The application of the roller-hearth furnace for normalizing has various advantages over the batch-type furnace in that heating and cooling gradients are more uniform and can be more accurately controlled in furnaces where the charge is kept stationary for a long period. This type of furnace has been extensively used for the heat-treatment of non-ferrous strip, and its application to steel strip is increasing. The advantages and behavior of the roller-hearth furnace in continuous normalizing of strip are explained. *Sheet Metal Industries*, June 1941, page 753.

Some Notes of a Metallurgist on the Rolling of Magnesium. F. A. Fox. A brief study of the properties of magnesium as related to the treatment and mixtures necessary to provide the original metal with sufficient ductility for rolling. *Sheet Metal Industries*, April 1941, pages 490, 491, 2 illus.

Meteorology

On the Interpretation of Temperature Measurements Made at High Levels. J. C. Ballard. A discussion of sources of error in temperature measurements made at high levels. The causes of error particularly considered are those which, according to the investigator, have not yet been satisfactorily evaluated. They are stated as: (a) the effect of insolation if the observations are made during the daytime, (b) the effect of radia-

tion from the instruments during night observations, and (c) the effect of lag in the temperature elements.

In this study, a report is made of attempts to evaluate the magnitude of these effects in the sounding balloon data obtained by the Weather Bureau during the International Month, July 1938, at Omaha, Neb. The first portion of the report furnishes a general description of sounding balloon technique, and the second treats of more recent details regarding the balloons used and the arrangement of equipment. *Monthly Weather Review*, February 1941, pages 33–40, 5 illus.

Finding Ceiling Heights at Night. Description and working principle of a night ceiling projector in use at many Canadian airports. It consists of a searchlight and "alidade," or angle sighting instrument, mounted 1,000 feet from the projector. The alidade is sighted on the spot of light at the base of the overcast and its height is read on a calibrated index. *Commercial Aviation*, June 1941, pages 23, 24, 3 illus.

Frontology in the Antilles. S. Frolow. A study of weather fronts in the Caribbean. In an introduction to this paper by R. G. Stone it is stated that due to the lack of synoptic reports, and to the fact that air mass behavior in the tropics differs from that of the temperate zones, weather forecasting in the Caribbean on a day-to-day basis has only lately been developed. The writer, Chief of the Meteorological Service of Martinique, has contributed to this development by his work in isallobaric analyses of weather charts both in West Africa and Martinique. In this paper he discusses recent findings in the latter area. *The Bulletin of the American Meteorological Society*, May 1941, pages 198–210, 20 illus.

Fog Study of Miami, Florida. John Randle DeHart. Awarded first prize for 1940 by the Air Transport Association of America "for the best research, by an airline employee, having practicable application to meteorology or dispatching," this paper is the result of a research program to devise a means for forecasting fog at Miami.

As advection plays an important rôle in every case of low visibility for this area, the geographical location of Miami is significant. Opening, therefore, with a brief examination of this relationship, the paper continues with a description of seasonal variations in the area and discusses factors governing qualitative and time estimation of fogs.

Cases of radiation-advection fog and post cold frontal fog are analyzed to show the typical sequence of events for these types of fog in this particular area, as a basis for forecasting. The study was made from Eastern Air Lines' maps drawn and analyzed at six-hour intervals from 1935 to 1940. All frontal analyses and air mass designations are their own. *Journal of the Aeronautical Sciences*, July 1941, pages 357–360, 10 illus.

A Slide Rule for Determining 10,000-Foot Pressure. J. R. Fulks and R. A. Dightman. One of the many problems confronting meteorologists engaged in airway forecasting lies in the lack, during adverse weather, of current wind-aloft data. It is during such periods that accurate data concerning upper-air circulation are most important in properly planning instrument flights.

The present article explains the method now employed at the Seattle Airport Station of the Weather Bureau in determining 10,000-ft. pressure. It is suggested that this method may be used to advantage in regions where there is a scarcity of reports of winds, and pressures aloft, and in particular, when there is a limited amount of time available for such determinations. *Monthly Weather Review*, March 1941, pages 71–73.

The Anatomy of the Air. Eric Sloane. An aviation artist sketches a lesson in air currents for the pilot. Locations of updrafts, downdrafts and turbulence in relation to the terrain beneath are shown with short descriptive captions. *Air Trails*, July 1941, page 21, 1 illus.

Military Aviation

Flying Them Over. A tentative plan for flying American-built fighters to England *via* northern Quebec, Greenland, Iceland and the Faroe Islands. It is said that delivery by air is proving to be much safer and much faster than shipping by sea. The route under consideration is through northern Quebec to Fort Chimo, and from there to Lake Harbor. Hudson Strait could be crossed at a point less than 100 miles wide; the flight from Baffin Island to Greenland is about 200 miles. The over-water flight would be 250 miles from Greenland to Iceland, 300 miles from Iceland to the Faroe Islands, and 200 miles from there to Shetland, Scotland. Chief hazards would be landing facilities during the Summer, fog, and severe but local gales in Greenland. Engine operation and maintenance under conditions of extreme cold would also be a problem. It is stated that one advantage of flying fighters is that pools of fighters could be maintained at important air bases in Greenland and Iceland for purposes of defense as well as replacement. Temporary structural changes in ferried fighters are also described. *Canadian Aviation*, pages 29–31, 6 illus.

Gliders for Invasion. A description of methods and equipment which the Germans might employ in a mass glider invasion of England. The writer, a Polish engineer and former production director in a glider factory, undertook this analysis before the use of gliders over Crete. His statement that Germany not only has studied methods of attack by troop-carrying gliders but also used them in Holland is supported by the German air invasion of Crete. The writer believes that while the standard glider for this purpose would have a gross weight of about 12,000 lbs. gliders of 35,000 lbs. could be towed by four-engined bombers. *Canadian Aviation*, June 1941, pages 35, 44, 3 illus.

For Freedom's Skies. Jim Marshall. Popularized version of the problem of American airpower. The writer traces the rapid changes in American thinking and the equally swift increases in the aircraft procurement program. The quality of American aircraft and the military pilot training program are also discussed. *Collier's*, July 12, 1941, pages 16–21, 81, 82, 14 illus.

Atlantic Deliveries. Roger Tennant. Outline of various problems to be met in flying American military aircraft to England. Ferrying bombers to England by air has proved an ideal method of delivery from the standpoint of speed, safety, and numbers. As American production reaches its peak, all available shipping tonnage will be needed for tanks, guns, and equipment that must be sent by sea. Air routes across the Atlantic are discussed, although no mention is made of the proposed route for ferrying fighters. The problems of weather and fuel ranges of light bombers and fighters are touched on briefly. *Flight*, May 29, 1941, pages 378–380.

The Place of the Dive-Bomber. Major F. A. deV. Robertson. Outline of the development of the dive-bomber, together with a description of its functions. The first airplane of this type on record is said to have been the Curtiss Helldiver, developed

for the U.S. Navy. The Germans were first to employ dive-bombers in large numbers against ground positions with an effect similar to concentrated artillery fire. Current types of British and American dive-bombers are described, and the probability that Germany will have to be beaten on land by coordinated tank and dive-bomber tactics is also discussed. *Flight*, May 29, 1941, pages a–d, 7 illus.

Navy Markings. William Larkins. An Associate of the U.S. Naval Institute describes the appearance and significance of markings used on aircraft of the U.S. Navy. *Air Trails*, July 1941, pages 22, 23, 59, 60, 17 illus.

Royal Air Force Bases in Malaya. Description of extensive facilities for maintenance and repair at R.A.F. air bases in the Far East. Each is practically a complete unit in itself with machine shops, engine and airframe workshops, and divisions for the repair of instruments, armament, and radio. Each base also has training facilities and equipment to provide manpower for the greatly expanded operations of the R.A.F. in the Far East. *Flight*, June 5, 1941, pages g, h, 6 illus.

British Air Power, Major F. A. deV. Robertson. An outline of the organization of British air power, which, according to the writer, "must be capable of use in three ways: (a) as an independent force, (b) in support of the Navy, (c) in support of the Army." Organization, duties, methods of operation, and types of aircraft used are described for the Fleet Air Arm, the Coastal Command, the R.A.F. Fighter and Bomber Commands, and Army Cooperation Squadrons. *Aviation*, July 1941, pages 30, 31, 168, 3 illus.

The Air Defences of Latin America. Raymond Arthur Davies. A review of current strength of South and Central American Air Forces. During the past year the twenty republics of Central and South America have expanded their air forces as rapidly and extensively as their own finances plus American credit and aircraft production would permit. Recent activities of the principal countries are briefly outlined. *Commercial Aviation*, June 1941, pages 17, 18, 30, 9 illus.

Atlantic Ferry Service. A brief account of the organization of the service which is now making regular transatlantic delivery flights of Boeing B-17C, Lockheed Hudson and Consolidated Liberator bombers. "Atfero," a civilian company formed by the Canadian Pacific Railway with headquarters at Montreal, organizes the work and arrangements of the ferry service under the directional authority of the Ministry of Aircraft Production.

Pilots and crews are recruited from British Airways and Air Transport Auxiliary, and many American volunteer pilots have also been recruited. Most of the bombers have been flown direct to England, but the Consolidated Catalina flying-boats have flown *via* Bermuda on occasion. As information on transatlantic ferry activities is more restricted in England than in this country, this article includes extracts from recent articles on the subject appearing in American publications. *The Aeroplane*, May 30, 1941, pages 605–607, 5 illus.

The Austin Company

An open type spray booth which permits painting aircraft without taking them from the assembly line is one of the innovations at Bell Aircraft Corporation's new Niagara Falls plant. Fumes are drawn down through the floor grille and exhausted through the roof.

That Secret Bomb Sight. John R. Hoyt. General description of the use of a bomb sight and some of the reasons why America's bomb sight is such a closely guarded secret. It is stated that while many officers, students and instructors in the U.S. Services know how to work the sight and have had months of practice in its use, even the manufacturers do not know *how* it works. Only a few persons in the entire country know or understand its principle of operation and mechanism. Its value lies in great accuracy at extreme altitudes, and one of the problems for which it must compensate is the several changes of wind direction and velocity encountered by bombs dropped from great heights. An interesting training apparatus used for ground practice with the sight is also described. *Air Trails*, July 1941, pages 16, 17, 62, 5 illus.

Flivver Patrol. William Strohmier. Light airplanes are patrolling the coasts of England and Scotland, according to the writer. Small private airplanes are being flown by pilots ineligible for military service as an aid to the Coastal Command in patrol work. More than 200 persons trying to smuggle into England have been caught with the help of these light-plane observers. It is suggested that a similar plan be considered for the coastal areas of the United States, also that light aircraft be flown off merchant ships equipped with flight decks, and be used for aerial observation work with convoy patrols. Possibilities of light airplanes for observation and liaison work with the Army are also described. *Air Trails*, July 1941, pages 14, 49, 50, 2 illus.

The Air Corps Ferry Command Under Colonel Olds. Outlining this program recently set up under Col. Robert E. Olds, U.S. Army Air Corps, it is pointed out that besides speeding bomber delivery to Britain and releasing for active service additional skilled British pilots who have been engaged in this work, the Air Corps Ferry Command will broaden the facilities for training American pilots in the handling of large long-range bombers.

The Air Corps is to maintain its own inspectors at assembly points and is to utilize Air Corps facilities in some particulars for speeding final assembly, such as equipping and arming, making final installations of various kinds, etc. The Ferry Command is to have inspectors at every plant making either aircraft or essential components of planes. The unit is to chart production, maintain progress reports on every item and coordinate output.

The organization is to determine when a plane is ready to leave the assembly plant, after which it may be flown to an intermediate station, or may be put in final order at some Air Corps station. This alternative will be utilized wherever necessary to relieve a private plant of this detail in order to concentrate on production. It appears that the British Air Ministry has established a similar unit by shifting control of its present ferry service to accelerate production, though the British unit is not of a military character. *U.S. Air Services*, July 1941, pages 9, 10.

Defenders of the Night Sky. A brief account of the facilities and organization of the night fighter force operating in defense of Britain. Among the new types now in this service are the Bristol Beaufighter, a twin-engined airplane just recently, released, and the Douglas Havoc, a

variation of the Boston bomber (DB-7B) having tricycle landing gear.

The description of the ground organization for night fighters indicates a ground control that is constantly being improved. It operates much in the manner of ground station control systems for airlines, pilots being kept constantly in touch with the station. Greatest handicap to night fighter pilots would seem to be the visual problem of identifying other aircraft, since the pilot is expected to be positive of identification before making an attack.

Because of the great strain attached to the night fighter pilot's work and the attendant hazards, he receives many concessions and privileges in certain respects uncommon to other service branches. The resultant *esprit de corps*, the growing aids being developed for fighter control and operation, and the acquisition of growing numbers of improved types of night fighter airplanes are said to be largely accountable for the increasing success of this branch of air service. *The Aeroplane*, June 6, 1941, pages 623, 624, 4 illus.

Model Airplanes

Checking Your Gas Engine. Arthur Vhay. Description of the operation of a gasoline engine for model airplanes. A list of common causes of engine failure is included. *Air Youth Horizons*, June-July 1941, pages 7, 8, 3 illus.

The Apache. Part Two. Henry Struck. Continuation of an article on the construction of a high-performance power model with slotted wings and spoilers. This portion contains drawings and details of wing and tail construction and furnishes instructions for adjustment and flying. *Air Trails*, July 1941, pages 30–33, 6 illus.

Radio Control Gadgets. Thracy Petrides. Descriptions and drawings of radio control mechanisms for controlling the flight of model airplanes. Included are the conventional type of 90° intermittent escapement, the Geneva stop, a gear and cam device, a motor-driven gear and cam arrangement, a motor control, and the rudder control on a commercial model. *Air Trails*, July 1941, pages 28, 29, 63, 9 illus.

Sechszylinder-Sternmotore fur Flugmodelle. (Six-Cylinder Radial Engines for Flying Models.) A decription of the Pininasch P.13 1939 six-cylinder two-cycle rotary engine for model airplanes. Specifications are given. The hub of a three-blade, adjustable pitch, metal propeller is attached to the cover of the engine housing. The ignition timer is built into the propeller hub. The testing equipment for this engine had to be especially developed. *Schweizer Aero-Revue*, May 1941, pages 17, 18, 9 illus.

Models in the Air Corps. Douglas J. Ingells. A description of the miniature test models built for each airplane tested by the U.S. Army Air Corps at Wright Field. Included in the account are the individual wind-tunnel models used for testing the performance, stability, pressure distribution, drag, spinning, flutter and free flight of airplanes. From wind-tunnel tests of these models come valuable data on speed and performance. Methods used to support models in the wind tunnel are also described. *Flying and Popular Aviation*, July 1941, pages 24–26, 4 illus.

Naval Aviation

Aerial Vanguards of the Pacific. James Bassett, Jr. Description of Canton Island, one of the small Pacific islands in a 10,000-mile chain which could be used as defensive air bases. Naval experts are credited with saying that fortification of this 30 × 8-mile plot would give us a new stronghold directly across Japan's communication line from her home fleet ports. The Navy is said to be withholding further information about the development of these potential bases for military reasons. *Flying and Popular Aviation*, July 1941, pages 16, 17, 18, 102, 4 illus.

Parachutes

Op Zijpaden der Aviatiek—Het valscherm van vroeger—II (On the By-Ways of Aviation—Parachutes of Former Times—2). The second of a series of articles describing the development of the parachute chronologically. *Luchtvaart*, May 20, 1941, pages 199, 200, 1 illus.

Chute Control. Series of pictures and captions showing methods of parachute control. Included are right turns, left turns, right drift, left drift, land and water landing, and how to collapse the parachute upon landing. *Air Trails*, July 1941, page 19, 12 illus.

Op Zijpaden der Aviatiek—Het valscherm van vroeger—I (On the By-Ways of Aviation—the Parachute in Times Past—1). The first of a series of articles on the history of the parachute. The development of parachutes is chronologically described in this article, beginning with the rough sketches of Leonardo da Vinci and continuing with the work of Drouet, Garnerin, Henin, Robertson, Cocking and Green. *Luchtvaart*, May 6, 1941, pages 165, 166, 3 illus.

Personalities

Veteran of the Ocean Airways Now Training Air Corps Cadets. Maj. Frank L. Nelson. Short biographical sketch of Captain Carl M. Dewey, for seven years senior pilot of Pan American Airways. His recent appointment as technical head of Pan American's Navigation Section for the training of Army Air Corps navigators will bring under his instruction some 2,000 American boys and a number of Canadian and British students. *U.S. Air Services*, June 1941, pages 22, 38, 1 illus.

How High Is Up? Michael Amrine. Outline of the career of D. W. (Tommy) Tomlinson, vice-president in charge of engineering for TWA. Included is an account of Tomlinson's work in high altitude flying. *Flying and Popular Aviation*, July 1941, pages 22, 23, 100, 3 illus.

"Lucky" Wiggins. Dean Jennings. The story of the career of Mary Wiggins, one of the country's few feminine stunt flyers. Included in the account are some of her experiences as a movie double and parachute jumper. *Flying and Popular Aviation*, July 1941, pages 53, 54, 90, 2 illus.

Backwoods Ace. Leverett G. Richards. Career story of Vern Bookwalter who, during more than 20 years of frontier flying, has never injured a passenger. His flying career is described from its beginning, shortly after the World War, to barnstorming days and frontier airline flying in the Pacific Northwest and Canada. Over one of the routes which he flew for six years without loss of plane or cargo, now operate scheduled airlines, equipped with emergency landing fields, beacons and the finest radio equipment. *Flying and Popular Aviation*, July 1941, pages 55, 56, 102, 4 illus.

Personairlities. Cy Caldwell. A brief account of the career of John Gilbert Rankin, better known to aviation as "Tex" Rankin. He transferred from the Army to the Air Corps during the first World War, and after three months at a French air school was sent to Romorantin where he had charge of assembling American-made airplanes.

Later, he went to work in an air school at Spokane, bought himself an airplane and started his own school. Since then more than 3,000 pilots have been graduated by the school without a serious accident or fatality. Some of "Tex" Rankin's accomplishments as a stunt pilot are also described. *Aero Digest*, July 1941, pages 81, 82, 1 illus.

Plant Equipment

Onsrud Spar Miller. Description of construction of an American spar milling machine. Operating on a 30 ft. bed made up of two 15 ft. sections, the horizontal cutting head is 6 in. in diameter, turning 5,400 r.p.m. with a 20 hp. drive, electrical transmission from a trolley duct overhead. Horizontal and vertical pattern guide bars control the work surface. Other details of operation are given. *Aero Digest*, July 1941, pages 201, 205, 3 illus.

New Spotwelder Introduced. Details and specifications of a new aluminum alloy spotwelder which, by converting 3-phase alternating current into a secondary welding current of ideal wave form, dispenses with energy accumulators. The new method is said to achieve improved positive control of "output" or welding current, resulting in greater uniformity and weld strength. The latter is said to be 100 per cent above government requirements, with variations in weld strength of not more than 5 per cent.

It is said that improved current and time control permit welding of sections totaling 1/4 in., down to the thinnest weldable sheet, on the same machine. Also that no special skill on the part of the operator is required. Diagrams illustrating current conversion and several specimen welds are shown. Of special interest is a specimen weld of 7 sheets of 0.032-in. section 24 ST aluminum sheet. *Canadian Aviation*, June 1941, pages 50, 51, 4 illus.

Guarding Production Against Fire. George R. Jaqua. Description of the high-pressure carbon dioxide built-in fire prevention systems at the Wright Aeronautical Corporation's Paterson plant. Cylinders of liquefied carbon dioxide supply pipe lines to points of greatest hazard in the built-in system, while small portable units are available for areas not covered by the built-in system. Carbon dioxide in the cylinders is a liquid under 850 lbs. pressure. When released through pipes and special nozzles it immediately expands into its gaseous form. The combination of pressure and expansion drives the gas into all parts of the hazard area through even the smallest crevices. Arrangements of the equipment for different types of hazard area are described. *Aero Digest*, July 1941, pages 56, 58, 234, 7 illus.

Private Flying

Private Warplanes. Allan Greenwood. It is suggested that the 17,000 private airplanes, manned by 40,000 pilots, in this country be utilized for home defense. The cost of equipping a lightplane for bombing would be small, and a 5-lb. bomb rack could carry 100 lbs., the writer states. Protected by pursuit planes, this proposed air militia could be used as a defensive weapon in case of emergency. *Flying and Popular Aviation*, July 1941, pages 19, 20, 96, 2 illus.

Is Your Flying Safe? James L. H. Peck. An analysis of the basic causes of airplane crashes. Most accidents are said to be due to aerodynamic rather than psychological factors. *Flying and Popular Aviation*, July 1941, pages 27, 28, 96, 2 illus.

Sonora Argosy. Dudley B. Gold and Richard S. Dixon. Account of the flying activities of two Americans who work for a copper mining company in the mountain region of Sonora, Mexico. Lack of roads and the rough terrain make flying the most practical and inexpensive means of travel for pleasure. Their home field is 5,300 feet above sea level, and most of their flying is done at approximately 7,000 feet. A flight to the west coast of Mexico and return is described. *Flying and Popular Aviation*, July 1941, pages 33, 34, 98, 100, 3 illus.

Sky-Touring in Canada. James Montagnes. Suggestions for the American private flyer who plans a vacation trip to Canada. According to the writer, more and more private flyers are vacationing in Canada despite the war. Instructions are given for obtaining permission, filing of flight plans, and information on precautionary measures against flying over restricted areas. *Flying and Popular Aviation*, July 1941, pages 48, 92, 1 illus.

Flight Club. Robert de Roos. An account of the activities of The San Francisco-Oakland Flight Club. Formed in 1938, the organization began with group charter flights in large airplanes for week-end outings. This flight club is not a student flying group. Its main activity is low-cost, group charter flights over week-ends and on vacations.

This year, a trip has been booked to Chicago and among 22 other flights listed are three week-end ranch flights, an overnight camping trip, and other flights to interesting points in California. The club has 170 members. Membership is based on low monthly dues and special rates on all trips. *Flying and Popular Aviation*, pages 50–52, 4 illus.

Treat Them Gently. William D. Strohmeier. Suggestions to private pilots for giving the average person his or her first ride in an airplane. The writer, an active pilot, who has demonstrated light airplanes for years says that passengers on their first flight are inclined to be nervous and should be given a smooth flight so as not to leave them with a distaste for flying. *Air Facts*, July 1941, pages 10–13.

Planning the Future of Civil Flying. M. de Bunsen. The writer examines the possibilities for private flying after the current war is ended and points to some of the respects in which the war can be made a boon to peacetime aviation, but cautions that planning cannot be delayed until peace comes. The point of view taken particularly concerns flying clubs. *Indian Aviation*, April 1941, pages 91–94.

Private Aviation Again Defines Its Role in National Defense. An account of the talk given by Roger Wolfe Kahn at the annual N.A.A. convention and National Aviation Forum held at Louisville, Kentucky, June 1–5, 1941. *The Sportsman Pilot*, June 15, 1941, pages 16, 17, 44, 45.

Production

Engineering the Airacobra. Harland M. Poyer. Further engineering and construction details of the Bell Airacobra as described by the company's Chief Engineer. Particular attention is given to problems attending the design and engineering of the Airacobra's extended drive shaft. The airplane's tricycle landing gear and the engineering of the fuselage to withstand the recoil of its 37 mm. cannon are also discussed. *Aviation*, July 1941, pages 78, 79, 92, 6 illus.

Stainless Steel Fabrication. Aircraft fabrication of stainless steel as carried on at the plant of Fleetwings Incorporated, Bristol, Pennsylvania. Two pages of pictures and captions show steps of cutting, forming, welding, sub-assembly, and inspection of the finished assembly. *Aviation*, July 1941, pages 48, 49, 9 illus.

Perspective Drawings Simplify and Speed Production Procedure. The use of three-dimensional cut-away drawings which can be understood at a glance even by the untrained employee is outlined. Drawings which show assembly sequence and exactly where each part and sub-assembly fits in the completed airplane are helping to speed production at the Douglas

Aircraft Company. It is stated that five hundred such drawings are made for each type of military airplane. *Aero Digest*, July 1941, pages 151, 152, 160, 8 illus.

Practical Arc Welding. Francis H. Stevenson. Digest of a paper presented before the Western Metals Congress' meeting in conjunction with the American Welding Society. The writer describes step by step the welding of an engine mount. Sequence of assembly, jigs used, and procedure on each weld are outlined. *Aero Digest*, July 1941, pages 128, 130, 133, 234, 237, 12 illus.

Soft Metal Tools for Pressing Short-Run Panels. A review of technical advances and most recent methods used in the forming of airplane sheet metal parts. The purpose of improved methods is to improve the speed of production of such assemblies and still retain in them the optimum physical strength obtainable from the metal in use. Such properties can be destroyed by faulty forming practice.

Although it is usually emphasized that the use of soft metal and rubber tools is desirable for short runs for reasons of economy, other technical considerations suggest their strong advantage. These are enumerated: quite severe draws can be made by comparatively easy stages, avoiding the necessity for inter-stage annealing, and conserving the physical properties of the pressed metal; finishing of the die materials is quickly and cheaply performed; repair of cracked or chipped tools is a simple matter; new tool designs may be readily produced, even from remelted metal, with no lengthy casting and machining necessary.

The design, applications and use of a number of such soft metal tools are described. Forming machines, the simple drop hammer, the hydraulic press, punch and die materials, tool finishing and maintenance are discussed together with tool construction methods. *Sheet Metal Industries*, June 1941, pages 774–778, 783–785, 26 illus.

The Industry's Largest Engine Factory. More details and descriptive data on the new Wright Aeronautical Corporation plant at Cincinnati. *Aero Digest*, July 1941, pages 156, 159, 160, 205, 9 illus.

Powered Assembly Line Increases Vultee's Production. C. W. Perelle. Vultee Aircraft, Inc., has installed a powered, mechanized final assembly line, said to be the first of its kind in the Industry. It is a special overhead-conveyor system and the writer states that it has quadrupled output. Using a total of 6,280 ft. of overhead rail, the assembly system assures complete access to the aircraft at all times. Fifty per cent reduction in assembly time and 30 per cent reduction in necessary floor space have also resulted from its use. *Aero Digest*, July 1941, pages 162, 165, 166, 242, 9 illus.

First Blackout Plant for Manufacturing American Aircraft. J. G. Turnbull. Details of the new Dallas plant of North American Aviation, Inc. Dimensions are given and its construction and equipment are described. *Aero Digest*, July 1941, pages 185, 186, 189, 9 illus.

Getting 'Em Into the Blue. An account of the rapid expansion and increased production of Vultee Aircraft, Inc. Vultee's personnel soon will have increased from 950 to 17,000 employees in a little over eighteen months. The sequence of developments since the President's call for expanded aircraft production is discussed together with the elimination of 17 months from the time between preliminary design and final acceptance of new military types. The problem of training the new employee is also described. *Commercial Aviation*, June 1941, pages 39, 40, 52, 54, 6 illus.

Aircraft Tooling. Phil Koenig. The tool supervisor of Consolidated Aircraft Corporation outlines the tooling procedure and production of new models. General types of aircraft tools are described together with their use and purpose. The use of scrap aluminum in the making of tools and fixtures is explained as being due to its expansion and contraction in the same ratio as the component. Cooperation between the tool department and engineering department is said to be the first essential in the solution of any design problem. *Commercial Aviation*, June 1941, pages 57, 58, 7 illus.

Sperry—A Lesson in Industrial Planning. Carl Norcross. An outline of the inter-company organization of the Sperry Corporation together with a description of a few of the company's policies which have contributed to its success. The most important single factor in Sperry's management policy, according to "Tom" Morgan, president of the company, is its conception of the employee. The man on the job is the company.

The realization that Sperry's strength lies in its manpower, is said to be the keystone of the company's long-range attitude toward industrial planning. Every effort is made to keep its employees happy and satisfied. The incentive includes a periodic rate review for merit and performance; group life insurance; sickness, accident, and surgery benefits; and an employee suggestion system. Group effort is largely self-governed and freedom of mind and action backed by engineering talent has been responsible for the development of Sperry's many and varied types of products. *Aviation*, July 1941, pages 38, 39, 166, 168, 17 illus.

Putting the Small Plant to Work. Harvey L. Williams. The writer of this article undertakes to show how a maximum of the country's production capacity can be coordinated with the requirements of the defense program and placed in production on defense products. A specialist on "farming out" and sub-contracting, he outlines a standardized plan of procedure. It entails a careful survey of plant and machine shop facilities, and the bringing-together of prime contractors with much needed and qualified sub-contractors.

Problems of selling small sub-contractors on the necessity for immediate action on defense work, coordinating their production and supplies of raw materials and equipment, as well as education and training, are discussed. Several points essential to the success of the plan are emphasized. These include decentralization, taking defense work to the doorstep of subcontractors, knowledge of production facilities, knowledge of current production, and localized coordination.

The writer says that this plan is partly in operation in Massachusetts and Rhode Island and urges that a simple, standardized plan along similar lines be undertaken throughout the country. *Aviation*, July 1941, pages 34, 35, 142, 144, 146, 2 illus.

America Rolls Out the Warplanes. C. B Allen. Discussion of progress to date in expanding production of military aircraft in the United States. It is said that "despite the wishful thinking and production schedules heard in political circles," the aircraft industry is well ahead of its own production promises. Under present programs 18,000 military airplanes will be produced in 1941, and 30,000 in 1942. Recent production developments from several plants are outlined, together with descriptions of several of our military aircraft now in quantity production. *Popular Science*, August 1941, 66–73, 202, 24 illus.

The Development of Aircraft Spotwelding. Mabel M. Rockwell. An account of the rapid increase in the use of spotwelding machines at Lockheed Aircraft Corp. The special problems which attend the spotwelding of aluminum are discussed together with its advantages, especially those of the roll spotwelder. Power supply is said to have been a major

problem prior to the introduction of "stored energy" spotwelders, which charge up the transformer slowly with magnetic energy and then discharge it quickly to make the weld. It is said that this principle needs to be extended to roll spotwelders. Surface preparation, and the elimination of mechanical troubles are discussed together with recent research activities in design to take advantage of the economies of spotwelding. *Aviation*, July 1941, pages 42, 43, 162, 4 illus.

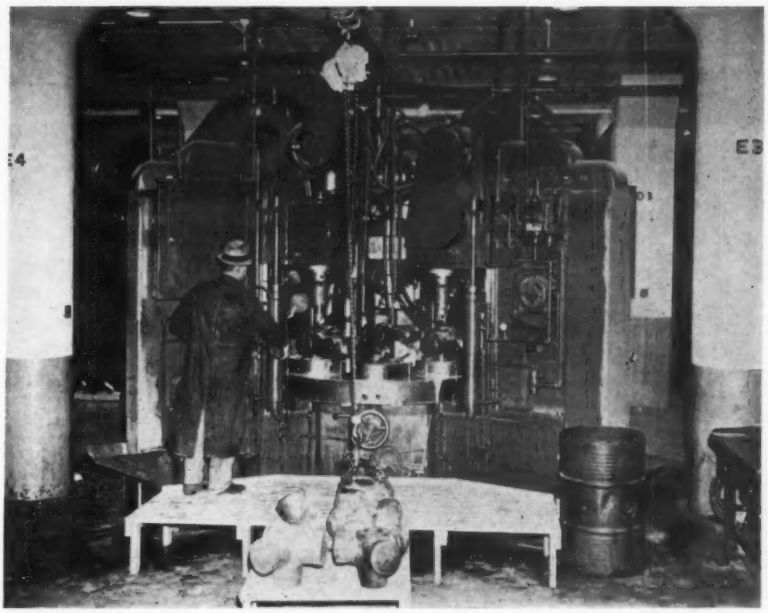
Spotwelding Studied in Plane Production. An outline of recent developments in spotwelding aluminum and magnesium alloys at Bell Aircraft Corporation's Buffalo plant. Included is a brief description of spotwelding light alloys. *Canadian Aviation*, June 1941, pages 48, 49, 2 illus.

Making Manifolds for Ansons. Experiences of the Cockshutt Plow Company, Ltd., in producing aircraft components are described to show how unrelated manufacturing facilities were adapted to the fabrication of manifolds, struts, flaps, ailerons, parts and other components for aircraft. *Canadian Aviation*, June 1941, pages 45–47, 6 illus.

Lift in the Assembly Shop. When bombers are assembled, they are usually lifted some distance so that various movable components on the airplane itself can be tested. The components commonly tested are the retractable undercarriage gear, the bomb racks in the wings, and the landing flaps. A mobile jack apparatus developed to meet the special requirements of this kind of lifting is described in brief. The unit can be moved any place desired, be fitted to any type of airplane, and is operated hydraulically by remote control. *The Aeroplane*, June 13, 1941, page 660, 2 illus.

Development During Production. Report of a paper by Henry C. Hill, engineer of the Wright Aeronautical Corp., on the subject of "More Aircraft Engines for National Defense." Delivered before the March meeting of the S.A.E. aircraft section, the paper pointed out that the development of the airplane engine in the United States marked the simultaneous development of a new design and manufacturing technique quite different from automobile manufacture.

Three important factors in modern engine production were described as: (1) research, experiment and proof-testing for practical results; (2) using the finest materials and manufacturing processes; and (3) flexibility in the manufacturing scheme for continuous absorption of detail improvements as they become available.



A Baker Vertical machine, in operation at the newly opened Indianapolis plant of Curtiss-Wright Corporation's Propeller Division, drills five hub forgings at the same time.

The problem has been, it was said, to mould mass-production principles to suit this new technique. This has been accomplished by making parts fast enough to afford a definite proportion of working time allocated for changing tools and fixtures to incorporate changes in the design of the article. *The Aeroplane*, May 23, 1941, page 576, 1 illus.

50,000 Airplanes. J. H. Van Deventer. An analysis of the meaning of this production objective in terms of manufacturing technique, absorption of labor and raw materials. These factors are discussed particularly from the point of view of airplane production expansion through the medium of automobile manufacturers' participation and technical aid. Comparisons are made to show both the gargantuan task involved in this program and the extent to which mass production must be achieved on an unprecedented scale. *The Iron Age*, June 5, 1941, pages 43–47, 114–119, 3 illus.

Vega Opens Ultra-Modern Plant. A brief review of the Vega Airplane Company's expansion during the past year. It is stated that in a single year the number of employees has increased from 600 to 4,500 and its backlog from none at all to one of $75,000,000. Plant layout and details of the assembly line are described. *Commercial Aviation*, June 1941, pages 60, 82, 1 illus.

Metal Processing in the Aircraft Industry. Ray Sanders. The vice-president and general manager of a company specializing in cleaning compounds discusses the increased use of metal cleansers in metal processing. A chart is included to show methods and materials used. *Aviation*, July 1941, pages 46, 47, 3 illus.

"Uqusbakning" i USA ("Baking in the Oven" in the U.S.A.). A study of the use of plastics in the aeronautical industries in the U.S. A description is given of the plastics produced by Du Pont, the Bakelite Corp., and the Haskelite Corp. Reference is made to a previous article on an airplane made of plastics by the Trimm Aircraft Corp. Also outlined is the work of A. V. Clark of the Clark Aircraft Corp., a division of the Fairchild Corp. He developed the plastic duramold which is used in the Fairchild 46A. The manufacturing methods used in producing this airplane are explained. *Flygning*, April 1941, pages 6, 7, 4 illus.

Onkel Sams flygindustri just nu (Uncle Sam's Aeronautical Industry at the Present Time). A review of the great expansion and intensified construction program of the American Aeronautical industry. Among the firms mentioned are: Allison Engineering Co., Boeing Aircraft Co., Brewster Aeronautical Corp., Curtiss-Wright Corp., Douglas Aircraft Co., Lockheed Aircraft Corp., The Glenn L. Martin Co., North American Aviation, Inc., Northrop Aircraft, Inc., Vultee Aircraft, Inc., and Wright Aeronautical Corp. *Flygtidningen*, March 1941, page 6, 2 illus.

Propellers

Hydromatic Airscrews in the Making. A page of photographs showing various propeller manufacturing departments of the de Havilland Aircraft Company. The D.H. Hydromatic propeller is a full-feathering and constant-speed type of the variable-pitch propeller. Its manufacture requires the finest tolerances and great care in the setting up of tools in the machine-shop, together with thorough inspection of all the parts.

Among the views presented are the machine shop, a set of profiling machines at work shaping metal blades, the shop where the propeller barrels are machined, the department for machining of gear segments and domes and dome assembly and inspection. *The Aeroplane*, June 6, 1941, page 629.

Expansion of Facilities for Curtiss-Wright's Propeller Division. Figures on the rapid expansion of the Curtiss-Wright Propeller Division during the past few years, together with a chronology of development of the Curtiss electric propeller and a description of the new plant at Caldwell, N. J. *Aero Digest*, July 1941, pages 144, 146, 233, 3 illus.

A New Design for a Contra-Prop. A brief statement of the advantages claimed for a recently patented English design for epicyclic pitch changing gear for a controllable pitch propeller. The gear can be applied directly to concentric, oppositely rotating propellers. In normal operation the whole train of gears rotates as though "solid." To vary the pitch of the blades, extra motion is transmitted through the external pitch-control shaft. In this manner, the blades can be turned from the full feathering position around to a reverse pitch. As there is no internal apparatus, a cannon can be arranged to fire through the propeller shaft. *The Aeroplane*, June 6, 1941, page 636, 3 illus.

Radio

La radiogoniometria e la sua applicazione nella navigazione aerea (Radio Direction Finding and its Application to Air Navigation). An article explaining somewhat simply the use of radio waves in aerial direction finding. It describes the sending and receiving instruments, the various types of antennae used, and the reception of radio beacons. *Schweizer Aero-Revue*, May 1941, pages 26, 27, 3 illus.

Development of an Improved Crystal Exciter Unit. C. H. Jackson. A crystal oscillator multiplier circuit of high stability and output power is described, and the factors affecting the stability, crystal current, and output power of the oscillator are discussed. Particulars are given on an exciter unit for an ultra-high-frequency transmitter which makes use of the crystal oscillator multiplier in conjunction with an 807 type tube as a multiplier. *Civil Aeronautics Authority, Technical Development Report*, No. 26, July 1940, pages 1–15, 17 illus.

The Effect of a High-Frequency Disturbance on the Direct-Current Corona From a Sharp Point. Marcus O'Day. The first of this report's three sections comprises a study of the nature of the radio interference caused by a point in d.c. corona. It is shown that the wave form of the radiation emanating from such a point is similar to that obtained from a relaxation oscillator.

In the second section, the report draws a comparison of the conductivity of the d.c. corona from a sharp point with and without the superposition of a radio-frequency corona on the same point. The formation of a radio-frequency corona is shown to increase the conductivity from 4 to 20 times that of the d.c. corona alone.

The last part of the paper is a study of the suppression by means of a high-frequency field of the radio-frequency disturbances originating from a point in intermittent d.c. corona using a frequency of 5.8 megacycles. The nature of the discharge originating on the point is found to be so modified as to eliminate entirely the radio interference. *Civil Aeronautics Administration, Technical Development Report*, No. 27, August 1940, pages 1–19, 25 illus.

The Development of an Improved Impedance Measuring Box. Henry I. Metz. Report of a project established to provide a design specification which could be used for the purchase of a quantity of improved low-frequency impedance measuring boxes to replace the units at present being used by C.A.A. field personnel, and to provide the additional units required to serve the needs of the expanded and modernized airways system.

A specification, based on experiences with the existing types of impedance measuring boxes and including certain refinements, was prepared and a sample unit purchased. Data are here presented on the tests conducted on this new unit and on the final specification which was prepared by the Airways Engineering Division for a purchase of a quantity of these units. *Civil Aeronautics Authority, Technical Development Report*, No. 25, June 1940, pages 1–14, 17 illus.

Rotating Wing Aircraft

Hovering Record. Brief account of the record-making flight by Igor I. Sikorsky in his VS-300 helicopter, in which he hovered for 1 hour, 5 minutes and 14.5 seconds, over an area of less than an acre. Mention is also made of the seaplane flights of the helicopter equipped with rubber floats. *Flight*, May 29, 1941, page 374, 2 illus.

El Helicoptero Sikorsky (The Sikorsky Helicopter). A brief review of the characteristics and design of the VS-300 which recently broke the endurance record for this type of aircraft by a sustained flight of 1 hour, 32 minutes and 30 seconds. *Aeronautica*, June 1941, page 36, 1 illus.

Self-Catapulting Autogiros for the Protection of Vargo Vessels. Paul Thomas. Outline of a plan for equipping cargo vessels with small flight decks from which autogiros could operate. It is said that these need not be larger than 50 × 80 ft., as the aircraft would use a jump take-off and nearly vertical landing. The autogiros could be used in relays for patrol, and could even drop depth bombs on attacking submarines. *Aero Digest*, July 1941, pages 69, 70, 233, 234, 3 illus.

Warfare

Holding Up the Army's Umbrella. This editorial analyzes the "strategic grounds" of Germany's success in the invasion of Crete. The reliance of Britain on ground defense in contrast to German reliance on air offense "marked the struggle in Crete as unique." German bombardment took the place of artillery support. The transport of troops by air sought to eliminate British naval strength from the defense. The bombing of airdromes on the island was calculated to deprive the garrison of air defense. Thus, transport, supply and artillery for invasion were provided by the air arm. For the defense, infantry, artillery and tanks were available on the ground, but German speed in replacement of men and materials was fully equal to the rate of destruction by the defenders.

The forcing of the R.A.F. out of Crete, as in Norway and Greece, was

made possible by the inadequacy of airdrome facilities—the inability to accommodate a sufficient air arm within sufficient range to defend air bases and at the same time resist enemy attacks on other objectives. The little-resisted path of Germany through the Balkans provided the enemy with bases undamaged by war and practically unthreatened by the British. To the British, the special value of Crete was its forward position. But the long gap between it and the rearward bases represented a corresponding misfortune when the island had to be defended.

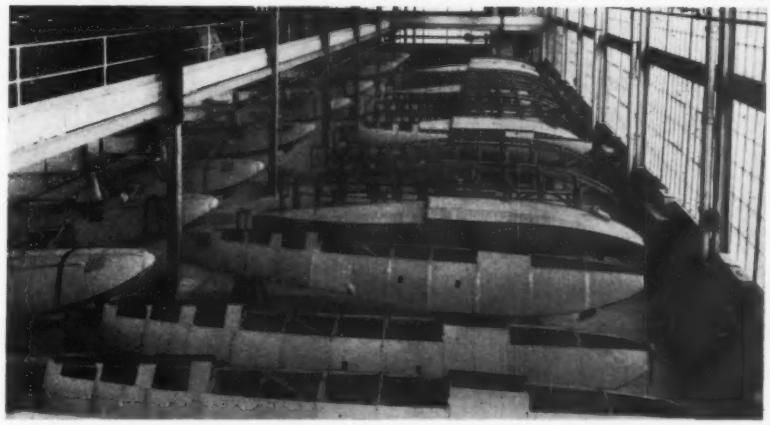
The invasion of Crete, it is contended, affords emphatic confirmation of the necessity for keeping fighter forces in the air wherever invasion threatens, and for providing adequate defense of home airdromes. *The Aeroplane*, May 30, 1941, pages 589, 590.

Bombs Across the Sea—Raiding America from Europe. Peter Masefield. In the opinion of this writer, it is possible for the German *Luftwaffe* to bomb New York and important aircraft manufacturing centers on America's eastern seaboard any time it wishes. The variable operational scope and bombing power of German and Italian airplanes are discussed in relation to existing and potential Axis air bases in Europe as well as in the Western Hemisphere.

Four possible methods of attack are suggested. Direct flights would be the most spectacular and "probably the most likely method of attack in the near future." Such flights could be made from airdromes on the coast of Norway, France, West Africa and from Portugal should that country be invaded. Minimum bomb load would be 1,000 lbs.; minimum round-trip distance would be 6,480 miles, *via* Brest-Montreal.

A second possibility is by the use of indirect routes. Long-range problems would be much relieved if landings could be made at intermediate points. Flights could be made from Norway by way of Greenland; from France and Portugal by way of the Azores (seaplanes only); from West Africa *via* Martinique or from Latin American airdromes. Minimum bomb load for such a flight would be about two tons.

Germany has had much experience in the operation of long-range flying boats from catapults on depot ships, the development of which suggests, a third potentiality. The use of aircraft carriers presents a fourth method of possible attack and is discussed in relation to Germany's present aircraft types. *The Aeroplane*, May 30, 1941, pages 597–603, 14 illus.



Final assembly of single float gear for the Vought-Sikorsky OS2U at the Edo Aircraft Corporation's plant at College Point, L. I.

Troops by Air. Discussion of probable methods used by the Germans in the air invasion of Crete. Gliders are believed to have been 15-passenger models, weighing about 6,300 pounds fully loaded. Reports from Crete indicate that glider trains were flown both in line on a single cable, and in Vee-formation on separate cables. In the latter instance the middle glider forming the point of the Vee is flown to the rear of the other two. Speed, construction, and probable methods of launching are also described. *Flight*, May 29, 1941, pages 371–373, 5 illus.

The 89th Week of the War in the Air. The weekly review of British air war efforts reiterates the necessity of complete air mastery if Britain is to win the war. Machines alone are insufficient—they must be better machines, faster, more heavily armed and armored, of greater range and load-carrying capacity and able to fly higher.

British air defenses are said to be immensely strong now by day; the night defense position is constantly improving. The "real weight" must be directed to the attack, in power and in plan. Uninterrupted, effective air offensive implies new tactics, the preparation of high-flying day and night bombers and the really high-speed day bomber which can cruise at speeds around 400 m.p.h. with a moderate load of bombs.

Production is now in a "really healthy state," finely dispersed so that it is not likely to be seriously injured by all the bombing the enemy can command. Development, however, is held to be less advanced and more overshadowed by red tape which clogs the wheels of production. Despite excellent new airplane types now in service, bigger and faster fighters, smaller and faster bombers, and both fighters and bombers which will fly higher and farther are the insistent demand.

Continued systematic operations of the R.A.F. Bomber Command are reported with data on victories and losses. The widening of the air war in the eastern Mediterranean sector is noted with news of R.A.F. air operations on that front. *The Aeroplane*, May 23, 1941, pages 567–569, 8 illus.

Squadron 71, Scramble! Byron Kennerly. Account of a busy day with the Eagle Squadron, R.A.F. The writer describes orders from Operations, the take-off, course and mission. First assignment is a Dornier bomber over a convoy, which is shot down just as German fighters arrive in answer to its call for help. The return to base is "vectored" or guided by position and course given by the all-seeing "Operations," and the Spitfires let down on their own field which is indistinguishable above 800 feet.

The second mission late in the day is a "big flap" with "many bandits," *i.e.*, fighting off a mass raid over Coventry. It ends for the writer in a spin down from 20,000 feet in a badly shot-up Spitfire. He levels off in time to land at a base miles away from his own. Ground crews, communications sequences, flight formations and methods of attack are described together with mental and emotional reactions to high-speed air combat. *Harper's Magazine*, July 1941, pages 171–180.

Night-Fighter Station. Walter Graebner. The R.A.F. is slowly but surely increasing its combat efficiency against night bombing raids. The writer describes a British night-fighter station and the Bristol Beauforts, or Beaufighters as they are now called, which have been converted from medium bombers to night fighters.

The use of a fast bomber for night fighting permits the mounting of the detector equipment in the nose and its fuel capacity gives many more hours on patrol between refuelings. Pilots, personnel and a typical night's operations at the station are described. *Life*, June 23, 1941, pages 82–85, 8 illus.

War in the Air. A review of recent activities of the R.A.F. Included is an account of the important part played by aircraft in the sinking of the *Bismarck*. The British evacuation of Crete, due to lack of defensive fighters for fighting off invasion by air, is discussed together with news of air action in North Africa. *Flight*, June 5, 1941, pages 389–391, 3 illus.

Eighty-five Raiders Down in Eight Nights. Carl Olsson. The writer states that while technique and equipment must remain a secret, the mounting toll taken by R.A.F. night fighters against German raiders represents a nearly prohibitive cost to the latter in men and aircraft. *London Calling*, June 22.

Night Interception. More details of night fighter operations by the R.A.F. The rapid strides in night fighter effectiveness during the past year are described together with the types of aircraft used. These include the Bristol Beaufighter, Hurricanes, Boulton Paul Defiants, and the Douglas DB-7s or Bostons, now rechristened the Havocs. The Beaufighter and Douglas Boston are light bombers converted for night fighting. *Flight*, June 5, 1941, pages 385–387, 4 illus.

Welding

The Welding of Non-Ferrous Metals. E. G. West. A review of literature published during 1939–1940 on the welding of non-ferrous metals. The purpose of the compilation, it is said, is to present as complete a picture as possible of the present position of non-ferrous metal welding and its problems. No effort was made to include all the works dealing with any particular aspect of the subject; it is noted that published information specifically on the non-ferrous metals is scarce. A number of elementary articles and papers of general interest are included in the review.

The collection is offered in the form of annotations, each given with the reference to its source. The study is assembled in three parts. The first treats of processes under the subject heads of general, personnel, gas methods, arc methods, other fusion processes, resistance welding and allied processes. Part 2, on materials, covers weldability, variation of properties with temperature changes, the effect of welding on the materials, and testing. The last section deals with technique and applications for individual metals, including aluminum, magnesium alloys, copper and its alloys, nickel and its alloys, zinc and its alloys, galvanized steel, and lead. Both a subject and a name index appear at the end of the review. *The Institute of Welding (British), Quarterly Transactions*, April 1941, pages 76–112, 2 illus.

The Spot Welding of Light Alloys. R. F. Tylecote. A review of published information on the spot welding of light alloys. It represents a compilation of available information on the subject up to the end of October 1940. The review is treated in textual form, a list of references and an author index appearing at the end of the article.

The phases of the subject reported are: weldability, machines, machine settings, surface preparation, electrodes, contract resistance, strength properties, stress distribution, heat treatment, cold working, hardness, corrosion, metallurgy, design, effect of pitch and current shunting, and shop practice. *The Institute of Welding (British), Quarterly Transactions*, April 1941, pages 56–75, 19 illus.

The Fluxing Action in the Gas Welding of Aluminum. E. G. West. Following the review of published information on fluxes for aluminum welding, this report describes experimental work on the properties of fifteen proprietary fluxes and 40 other mixtures recommended in patents and various other papers for welding aluminum. The investigation as reported includes melting point and hygroscopicity determinations, the solubility of alumina in molten fluxes and preliminary work on spreading power and the effect of flux on the apparent surface tension of aluminum.

According to the writer, the most striking result of the study was that, contrary to general belief, fluxes for the gas welding of aluminum do not depend for their efficacy on dissolution of aluminum oxide. The function of the flux is apparently to attack the basis metal, so removing the oxide mechanically, and then to take up the particles of detached film as a suspension. The efficiency of a flux thus appears to depend on the ease with which the halide ions penetrate the oxide coating. *The Institute of Welding (British) Quarterly Transactions*, April 1941, pages 50–55, 2 illus.

The Gas Welding of Commercial and Super-Purity Aluminum. E. G. West. A report on research into the factors which influence the weldability of metals. This article, presenting the aluminum phase of the study, compares metals of commercial purity with the same metals of the highest purity obtainable to ascertain their relative behavior in welding and the relative properties of the resulting welds.

Welds were made in four different works using aluminum of 99.5 per cent and 99.99 plus per cent purity, in the form of rolled sheet of three thicknesses—1/32 in., 1/4 in. and 3/4 in. Most of the welds were made on hard rolled test plates 1/4 in. thick, both free to move and constrained rigidly, using welding rods of the same composition as the basis metal and also a four per cent silicon alloy.

Observations were taken during welding and the resulting welds were tested radiographically, micrographically and mechanically. The results of all tests and observations are summarized and conclusions are drawn as to the relative weldability of the two types of aluminum, with reasons for the differences. The work led also to certain general conclusions relating to welding procedure and the testing of welds in aluminum. *The Institute of Welding (British) Quarterly Transactions*, April 1941, pages 31–49, 17 illus.

Electric Arc Welding of Aircraft Structures. Ralph Thorne. Description of electric arc welding of steel tube fuselages at Vultee Aircraft, Inc. Electric arc welding is said to have resulted in a production gain of 25 per cent. Reasons given are: (a) heat and flux are combined for simplicity; (b) there is no heating-up period with the electric arc as there is with gas; (c) intense heat of the arc allows immediate welding of each point along the weld, which makes it considerably more rapid on long welds. The welding equipment and training program at Vultee are also described. *Aviation*, July 1941, pages 44, 45, 164, 4 illus.

Spotweldability of Aluminum Alloys. Charles L. Hibert. Discussion of "an indefinable something that makes each spotwelding job different" which the writer calls "spotweldability." Causes of marginal cracks and porosity are described, together with surface conditions, methods of cleaning, and spotwelding equipment. The requirements and training of operators are also outlined. *Aero Digest*, July 1941, pages 190, 193, 194, 197–200, 4 illus.

Principles of Mechanics

In the third revised edition of this work, the authors present those principles of mechanics that are believed to be essential for the student of engineering. The expressed aim of the text is "to make the principles of mechanics stand out clearly, to build them up as much as possible from common experience (the student's experience), to apply the principles to concrete problems of concrete value and to emphasize the physical rather than the mathematical interpretation of the principles." A knowledge of elementary calculus is assumed throughout.

Previous editions of this text consisted of three parts, statics, kinematics and kinetics. The third edition has added a fourth part on special topics somewhat more advanced than those treated in the first three parts. A new chapter on mechanical vibrations has been included in this section.

The principal changes in the present volume are to be found in the addition of new problems and figures, the reduction of some of the textual discussion in the first three sections and more emphasis on variable forces. Many detailed changes were made in the presentation of the subject for the purpose of pointing up various ideas, concepts and principles which experience has proved especially difficult for the student to grasp.

Statics is discussed first because of its simplicity and its direct relation to the student's experience. The equilibrium of the various types of force systems is treated by both the algebraic and the graphical methods. Kinematics and kinetics are developed with regard for the increasing importance of dynamics for engineers; again in these sections, the mathematical interpretation predominates. A treatment of acceleration is given to aid in overcoming some of the difficulties frequently encountered in the use of this quantity.

In general, graphical methods of presentation and of solution are used freely. Following the practice introduced in the second edition, a list of review questions and problems is given at the end of each chapter.

Analytical Mechanics for Engineers, by Fred B. Seely and Newton E. Ensign; 3rd edition, John Wiley & Sons, Inc., New York, 1941; 450 pages, $3.75.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

Third Edition of Engine Text

As the author indicates in the preface to this third edition of Volume 2 of *The Internal Combustion Engine,* he has, owing to lack of time, entrusted to H. S. Glyde, his assistant for the past seventeen years, the work of checking over the 1931 edition, adding to the original matter in the light of more recent findings and rewriting entirely the chapter relating to Diesel engines.

The introduction of the new edition traces the development of the small mobile, high speed internal-combustion engine and especially notes the impetus given its design and development during the first World War. Today, weight-horse-power ratios have been reduced far below those of twenty and even ten years ago. It is said that the basic principles, both mechanical and thermodynamic, upon which the performance of such engines depends, have been studied and investigated so completely and thoroughly that the performance of any engine can be gaged with accuracy from a study of its design. Or, stated conversely, an engine can be designed to conform to any desired requirements or specifications.

Of the twelve chapters in this work, the first two deal with fuel and detonation, followed by two on distribution of heat and the form of combustion chamber. Succeeding sections treat of lubrication and bearing wear, mechanical design and mechanical details, valves and valve gear, piston design, road vehicles, heavy duty high speed engines for tanks, and high speed Diesel engines.

The High-Speed Internal-Combustion Engine, by Harry R. Ricardo, Revised 3rd edition by H. S. Glyde; Interscience Publishers, Inc., New York, 1941; 434 pages, $7.50.

Aerodynamics for Engineers

In the Spring of 1940, the Lockheed Aircraft Corporation asked the California Institute of Technology to cooperate in its expansion program by giving a course of aeronautical training to a group of graduate non-aeronautical engineers. Much of this material, of a technically advanced but general nature, is being published in three volumes on aeronautical engineering.

The book of Professor Millikan is the first of this series. It presents a brief but intensive summary of basic phases of aerodynamics which should be included in the background knowledge of any well-rounded aeronautical engineer. In view of the fact that this work is for the advanced student rather than a reference text for the specialist, the author has placed unusual emphasis on fundamental fluid mechanical principles, excluding to a large extent material of the handbook type. Methods of performance estimation and analysis are treated in some detail to serve the non-specialist who is frequently called upon for calculations or estimates in this branch of aerodynamics.

A discussion of general principles of aerodynamic forces, supported by a review of experimental data, forms the opening section of the book. A study is then made of the application of certain of these fundamental relations to specific aerodynamic questions; included in this section is a presentation of selected portions of the enormous body of experimental material which aerodynamic laboratories have made available in the last few years. Chapters on performance, and on the lateral and the longitudinal aspects of stability and control comprise the balance of the work.

The material is presented in a form suitable for students who have a working knowledge of the elements of mechanics and the fundamentals of differentiation and integration. However, certain problems are indicated, the complete treatment of which calls for more elaborate mathematical techniques. This treatment is intended to furnish a satisfactory and stimulating introduction to students who might subsequently enter more deeply into the field of aerodynamics.

Aerodynamics of the Airplane, by Clark B. Millikan; Jonn Wiley & Sons, Inc., New York, 1941; 171 pages, $2.50.

Jig and Tool Design

Intended not only as a reference book for experienced designers but also as a text for student production engineers, this work on the science of tool and jig design gathered most of its material from methods that have been in actual use over a period of years. The author for many years has been works manager of a large English equipment company. As a result, his book retains an intensely practical approach to the subject, the various phases of which are treated in logical sequence.

An efficient organizational setup for a jig and tool department is outlined, particular attention being given to the necessity for design of tooling to meet the requirements of economical production. In the study of actual production procedure, tolerance is discussed together with the basis for allowing and measuring it. In conjunction with this, tools such as gages, cutters and drills are explained with an outline of their uses.

While industrial progress changes the particular work, the basic principles of tool design remain essentially the same for all industries. The basic considerations such as time reduction, rigidity, cleaning and safety are defined as they prevail universally. The remainder of the book is devoted to the proper design of fixtures for various operations such as milling, grinding, broaching, etc., indicating the usefulness in mass production of fixtures operated by compressed air.

Production Engineering, by E. J. H. Jones; 2nd edition, George Newnes, Ltd., London, 1941; 308 pages, $5.00.

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Comprehensive Welding Text

Aircraft welding is simply an application of general welding principles to a particular field, as pointed out in this work. The text gives a description in non-technical terms of the design, materials and practices which have been found most satisfactory in modern aircraft construction.

While the book touches on all the methods used in joining aircraft metals, its specific concern is welding, the equipment and procedure used in various types of welding and the metallurgical processes involved in making and testing the weld.

In the review of general processes for joining metal in aircraft structures, methods and formulas are briefed for the design of these unions and the purpose and particular advantage of each type of union. The remainder of the book deals entirely with welding and its allied problems.

The characteristics of oxy-acetylene and oxy-hydrogen gases in welding, their properties and behavior and the apparatus used in applying these to welding jobs are outlined. The construction, use and maintenance of the valves, regulators and gas lines are explained. The art of welding and, the application of welding equipment, it is noted, can only be learned from practice and experience. General directions are given for preparing welds, executing them under varying conditions and for detecting and correcting faults.

The other types of welding are similarly treated. In examining the procedures used in the physical testing of metals, tension, compression, shear, bending torsion impact hardness and fatigue tests are described and the method for applying the conclusions are outlined.

The remainder of the work is devoted to the study of aircraft materials, their manufacture and treatment and their properties under various types of welds, with considerable attention to designing in relation to suitable welding procedure. The building and maintenance of jigs for welding are discussed along with general procedure for inspecting welds, determining the quality of raw stock, identifying specific materials and finding defects by chipping, X-ray, visual and magnaflux methods. The appendix contains many useful references such as standards for the construction of acetylene generators, arc and gas welding symbols, tube areas and tensile strength tables.

Airplane Welding and Materials, by J. B. Johnson; 2nd edition, The Goodheart-Willcox Company, Chicago, 1941; 409 pages, $3.50.

The Mechanic's Work

Apprentice mechanics frequently become confused by the vast amount of inherently unrelated information which they must absorb in order to get a complete picture of the master mechanic's work. This book attempts to condense the information which the seasoned military or commercial mechanic acquires over a period of years and to present it along with answers to the questions most likely to perplex the student mechanic and those most likely to be asked the student by examiners.

The field of airplane mechanics is broken down into general departments in logical sequence. A discussion of materials used in airplane construction describes their sources and the methods for processing them to bring out the specific properties required of aircraft materials. Gas, thermit, forge, arc, spot, resistance and seam types of welding are explained along with other methods for joining metals, such as soldering, brazing and riveting.

Much space is given to the study of modern airplane power plants. As in most textbooks, an examination of the general principles of four-cycle engines is presented in a practical review of actual working engines, their parts and functions and the relation of each to the function of the engine. Special consideration is given to lubrication, carburetion and ignition.

The treatment of the airplane is similarly handled. The work evidently assumes that the apprentice mechanic knows why an airplane flies, since this phase of the airplane study is mentioned in brief. Greater space is devoted to the members of the airplane, how they are put together and how they function. This treatment is extended to propellers, instruments and hydraulic equipment.

A chapter on Civil Air Regulations explains simply the requirements for a mechanic's license, the experience prerequisite and the legal responsibility of the mechanic toward the airplane and toward the Federal authorities. A concluding section furnishes a glossary of common technical terms.

Plane Facts, by Bert A. Kutakoff; Military Book Company, New York, 1941; 241 pages, $1.75.

International Engine Reference Book

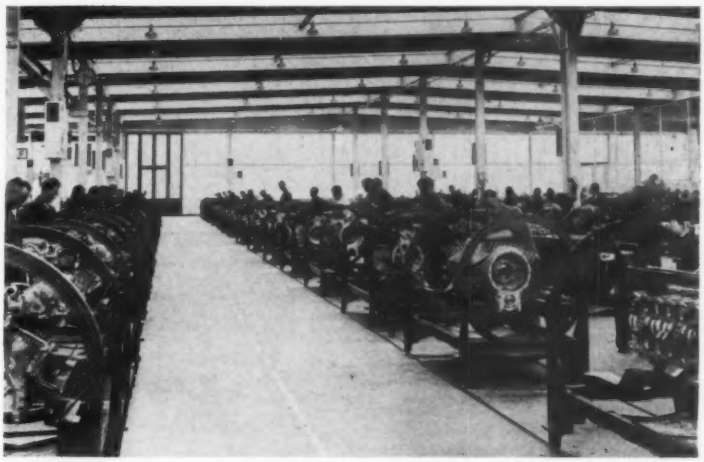
This reference book is devoted exclusively to the description of the latest power plants manufactured in this country and abroad. A full page of data, including specifications and performance figures in English and metric terms, and a full-page photograph are used to present each of 117 basic engines. Condensed information is included on 340 variations of these basic power plants.

In the introduction, the author describes the trend of aircraft engine development in the United States, France, Germany, Great Britain, Italy, Japan and the U.S.S.R., and the types of airplane in which each engine is used. The text is thorough and concise. The engines which range from 40 to 2,300 horsepower and include both gasoline and Diesel types, are arranged according to their country of origin.

The information for each basic engine is presented in a standardized form, the arrangement of which is as follows: First, a description is given which includes such items as type, construction and the major accessories with which each engine is equipped. This is followed by a tabulation of such details as bore, stroke, displacement, compression ratio, over-all diameter, weight, and weight per horsepower. Fuel and lubricating oil consumptions are given in units of weight. The fuel ratings include the new gasoline octane ratings as applied to military aircraft engines in the United States (73–91–100 octane). Power output per unit of displacement, power output per unit of piston area, maximum piston speed, and brake mean effective pressure have been calculated for the convenience of the reader. Other figures give the power output obtainable from the engine for take-off together with the boost pressure used, the rated (International) power output of the engine at its rated altitude, and the rated cruising power output. The condensed data on other models of each engine are included at the bottom of each page.

Some of the interesting new engines described include the 8-cylinder and 12-cylinder air-cooled Franklin developed in this country, the German Hirth 515, the British Rolls-Royce Kestrel XXX, the Italian C.N.A.D.-4, the Isotta Fraschini Beta and Asso L 180, and the Japanese Mitsuibishi Kinsei 14-cylinder radial.

The alphabetical arrangement of the index by manufacturer's name and model number makes it easy to locate any engine described. The concise, useful arrangement and scope of the book, which is different from that of any other engine reference book, will have a strong appeal to aeronautical engineers, students, manufacturers and others who wish complete data on the most recent engines being manufactured and developed by the major air powers.



Engine production in Germany; assembling Junkers water-cooled in-line aircraft power plants. From the introduction to *Aircraft Engines of the World, 1941*, by Paul H. Wilkinson.

Aircraft Engines of the World, 1941, by Paul H. Wilkinson; published by the author, New York, 1941; 256 pages, $7.50.

Air Express Economics

This comprehensive study of air express and air freight will provide those interested in this important element of the air transport structure with as complete data as have yet been published. While the author voices strong opinions as to the operation and functions of carrying goods by air, he is careful to present both sides of controversial questions.

The history of this phase of air transportation provides an excellent background for the discussion of the economics involved. The all-important relationship between transportation by high speed or slower aircraft is clearly presented. Rates and classification, pickup and delivery, and regulation are fully treated with annotations.

In the chapter regarding organization for a greater expansion in air express, the author presents definite views as to the need of a completely new setup. Whether or not his ideas are sound, the future will reveal; but in any event, he presents strong arguments for his position.

The concluding part of the study is devoted to exploring the possibilities of the field and to the essential statistical figures for comparing developments. The work is valuable, not only for its recognition of all the various points of view on the subject of this extremely important transportation development, but also for its references to other sources of information.

Some Economic Aspects of the Air Express Business, by Arthur Dee Lewis; published by the author, Austin, Texas, 1941; 120 pages, $2.50.

Metallurgy for Engineers

Keeping abreast of metallurgical developments as reported in the technical literature of metallurgy is difficult for those actively engaged in manufacture, processing or design involving the use of modern metals and alloys. Reflecting the significant progress in design and in the effective production of machines and structures, this book provides a concise, convenient study of recent revolutionary developments in ferrous and non-ferrous metallurgy and summarizes these fields for the engineer.

Safety, utility, durability and economical construction hinge extensively on the variables inherent in the manufacture and treatment of metals and alloys. The engineering properties of metallic materials, variables affecting them and the importance of these variables are discussed. The relation between constitution and structure of materials and properties is shown in an elementary discussion of fundamental modern concepts of physical metallurgy.

A section consisting of questions pertinent to the text will be of use to practicing as well as student engineers in pointing up the information presented in this work. An extensive list of references included should be most helpful in directing those interested in further reading and study of the subject.

Modern Metallurgy for Engineers, by F. T. Sisto; Pitman Publishing Corporation, New York, 1941; 426 pages, $4.50.

Engine Chart

For mechanics and for students, this reference chart and guide on the maintenance and periodic inspection of air-cooled radial engines affords a quick, comprehensive check. Brief technical descriptions of the lubrication and carburetion systems of typical air-cooled engines are furnished along with lists of important data such as oil and fuel specifications. Specific directions are included for starting power plants, particularly when cold or after remaining idle for long periods.

Among general instructions provided are directions for idling adjustment and such trouble-shooting problems as rough running, insufficient oil pressure, leak lines, etc. An outline of the function and characteristics of the mixture control is typical of the informative nature of the chart.

The section on periodic inspection is broken down into the parts that must be checked at stated intervals. A tabulation of proper operating conditions is included. The illustrations, which form an integral part of the textual material, are a cross-section photograph of a two-row radial air-cooled engine and schematic drawings of the oil circulation system, oil temperature control, fuel supply and blower systems.

Lubrication and Maintenance Chart, by Lieut. Col. Victor W. Pagé; The Norman W. Henley Publishing Co., New York, 1941; 28 × 38 in., $0.50.

Health for Fliers

As expressed by the authors, the purpose of this volume is to acquaint those who anticipate a flying career or those already engaged in aviation with the facts relevant to their health as fliers. To this end, they examine the problems of health met in everyday life, the periodic examination which each flier must regularly pass if he wishes to remain in the air, and the problems that arise as a result of flight itself.

In the course of twenty-three chapters, the authors ably and clearly discuss with a minimum of technical usage the information bearing on these major phases of their subject. While the information presented should be of value to fliers in any class, the physical and "mental" requirements of the aviator appear to be treated rather more in terms of military and commercial aviation in which these requisites are more stringent than in private flying.

A somewhat unexplored subject is discussed in a section on mental hygiene. Chapters dealing with ordinary mental and physical tests, disease, the effect of lack of oxygen and acceleration furnish a good understanding of these phases of keeping fit to fly. The book will well serve the intelligent lay public, specifically the individual who will or has made a career of aviation.

Fit to Fly, by Lt. Col. Malcolm C. Grow and Capt. Harry G. Armstrong; D. Appleton-Century Company, Inc., New York, 1941; 387 pages, $2.50.

Study of Photogrammetric Formulas

An analysis of photogrammetric formulas based upon the tilt displacement geometric progression derived by means of the Brook Taylor perspective. This booklet is a supplement to *Applied Photogrammetry* by the same author. Tilt formulas are derived as a function of the tilt, yet are applicable when the tilt is unknown, as in the initial computation. Calibration methods covering extreme relief and obliques are presented. Suggestions are given for a procedure in computing tilt and elevation by means of Abram's Contour Finder.

Rigorous Analysis of the Scale-Point and Tilt Formulas, by Ralph O. Anderson; published by the author, Chattanooga, 1941; 105 pages, $1.50.

Aviation Annual

The 1941 edition of this work carries forward its reputation as the standard reference book of the American aircraft industry. Edited, as usual, by Howard Mingos for the Aeronautical Chamber of Commerce, it is an indispensable source-book on the progress of aviation in this country.

In the earlier chapters, the use of air power in the present war is described and the participation of the aircraft industry in the great production program is outlined. The work of each of the many aviation activities of the government is reviewed for the year. The training and educational plans which have grown to such large proportions receive special attention.

As before, sections of the book deal with private flying, aircraft organizations and their work, airports and airways. The descriptions of the products of the aircraft industry have always been the most significant part of the annual for the twenty-three years it has presented this record of the program of American aeronautics.

The book is the publication which comes nearest to being an official reference work for governmental services and is standard for use in libraries, colleges and laboratories.

The Aircraft Year Book for 1941, Howard Mingos, Editor; Aeronautical Chamber of Commerce of America, Inc., New York, 1941; 608 pages, $5.00.

British Advanced Air Striking Force

On September 1, 1939, squadrons of British bombers flew from their home bases in England and landed in France. They were the vanguard of the Advanced Air Striking Force, and for over nine months they remained Britain's front line of the air. This is the story of the formation, history and exploits of this air organization during its campaign in France.

The author, a well-known radio commentator, shows—as far as censorship permits him to do so—why the British and French were unable to prevent the invasion of France. He describes the activities of French Fifth Columnists and Nazi spies and the gallant but unsuccessful efforts of a small number of British fighter and bomber pilots to stem the advance of the *Luftwaffe*.

First Blood for the R.A.F., by Charles Gardner; David McKay Company, Philadelphia, 1941; 272 pages, $2.50.

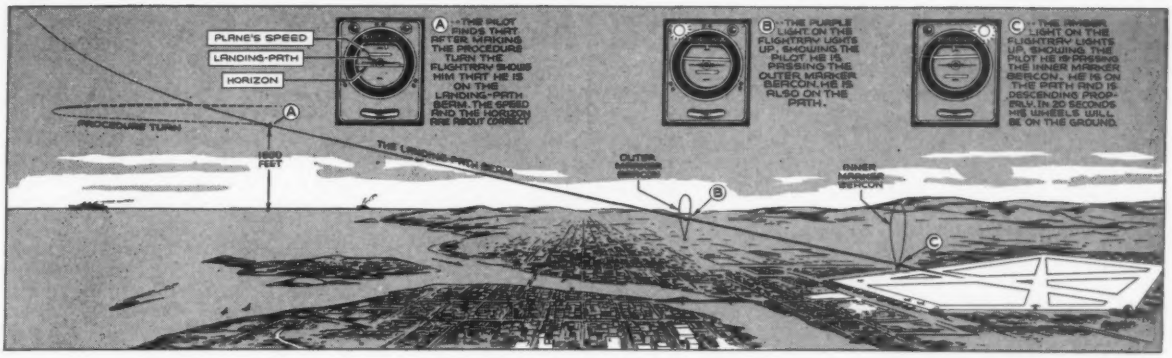
Accessory Equipment

Written by an engineer of the Eclipse Division, Bendix Aviation Corporation, this work affords an up-to-date handbook of useful information on aviation accessory equipment.

Comprehensive treatment is given to generating equipment, starter and vacuum instrument pump accessories, and hydraulic equipment. Chapters are also given to de-icing equipment, fuel flow-metering devices, and miscellaneous equipment such as hydraulic motors, warning devices, ammunition rounds, counters and contactors, and auxiliary power supply systems.

Details of maintenance, inspection and adjustment are described. The book is illustrated with a wealth of material supplied by the author through the courtesy of Eclipse.

Aircraft and Power Plant Accessory Equipment, by Sidney H. Webster; National Aeronautics Council, Inc., New York, 1941; 151 pages, $1.00.


PLANE'S SPEED
LANDING-PATH
HORIZON
A
PROCEDURE TURN
1500 FEET
THE LANDING-PATH BEAM
OUTER MARKER BEACON
INNER MARKER BEACON
B
C
A—THE PILOT FINDS THAT AFTER MAKING THE PROCEDURE TURN THE FLIGHTRAY SHOWS HIM THAT HE IS ON THE LANDING-PATH BEAM, THE SPEED AND THE HORIZON ARE ABOUT CORRECT
B—THE PURPLE LIGHT ON THE FLIGHTRAY LIGHTS UP, SHOWING THE PILOT HE IS PASSING THE OUTER MARKER BEACON. HE IS ALSO ON THE PATH.
C—THE AMBER LIGHT ON THE FLIGHTRAY LIGHTS UP, SHOWING THE PILOT HE IS PASSING THE INNER MARKER BEACON. HE IS ON THE PATH AND IS DESCENDING PROPERLY. IN 20 SECONDS HIS WHEELS WILL BE ON THE GROUND.

How the Sperry Flightray is used in making instrument landings. From *Safety in Flight* by Assen Jordanoff.

Maps From Aerial Photographs

The third revision of a work on photogrammetry, or the science of producing maps from aerial photographs. This is considered a complicated process by many, because of the customary method of working the problem on a three-dimensional basis, treating tilt and relief simultaneously. This requires great expertness in both calculus and solid geometry.

The method outlined in this work handles tilt and relief separately, requiring no mathematical knowledge beyond plane geometry and trigonometry. The system permits the work to be done graphically on the back of the photograph with regular drawing instruments.

In the third edition, a shorter and more direct derivation of expression for the position of the scale point is presented, together with an exact derivation of the tilt displacement formula. Small terms are not discarded as in the second edition. Certain errors in the second edition were corrected, diagrams altered and footnotes added. Superfluous material has been omitted and other minor changes made to simplify reading.

Applied Photogrammetry, by Ralph O. Anderson; 3rd edition, published by the author, Chattanooga, 1941; 191 pages, $3.00.

Continued Study of Flight

It has often been said that anyone can be taught to "drive an airplane." But patient practice, study and, above all, time are necessary to acquire the knowledge, judgment and experience which distinguish a safe pilot.

In this, his most recent work, the author takes up some of the subjects with which the safe pilot must become thoroughly familiar—subjects in which a thorough understanding of theory must be combined with constant practice and application in flight. Flying is safe only when the unknown element is removed and knowledge replaces uncertainty.

Key elements in safe flying are weather, or meteorology, and navigation. The major part of this work, which the author calls a natural outgrowth of the great need for post-graduate information on flying, is devoted to these two phases of flying knowledge.

The first seven chapters deal with weather fronts, not in terms of meteorology, but in terms of flying. Illustrations depict problems of flight through different types of front. Alternate airports are shown together with cloud formations ahead and behind the front. Weather conditions in which icing may be encountered are also illustrated and explained.

The sections on navigation are confined to radio-range flying, orientation, instrument approach, and position-finding by radio cross-bearings. The use of the Sperry artificial horizon and directional gyro are explained. Also discussed is the Lear gyromatic navigator, which combines the automatic radio direction-finder with a directional gyro.

The flight characteristics of aircraft with high wing-loading, airplane and engine accessories and physical fitness are treated among other general aspects of flying. Written as a continuation of the earlier books, *Your Wings* and *Through the Overcast*, this work bears the author's usual stamp of simplicity and clarity in presentation.

Safety in Flight, by Assen Jordanoff; Funk & Wagnalls Company, New York, 1941; 371 pages, $3.00.

American Aircraft

Young American aviation enthusiasts will find this timely book very interesting. The author, whose first book *Sky Roads* is considered one of the best books on flying for young people, describes in detail more than forty different airplanes manufactured and flown in this country.

The airplanes selected have been classified into three groups: commercial air transports, which include the DC-3, the Boeing Strato-Liner, and the Boeing Clipper; private aircraft carrying two or three persons for sport or commutation; and military aircraft, which include such military types as the Flying Fortress, the Bell Airacobra P-39 and the Vultee Vanguard.

These airplanes and others have been chosen because each is considered by the author as the outstanding one of its class and type. The descriptive text is brief but to the point and contains many excellent photographs which show the planes in flight as well as on the ground.

All American Aircraft, by Ernest K. Gann; Thomas Y. Crowell Company, New York, 1941; 128 pages, $2.00.

Primary Navigation Test

Due to the condensed simplicity of its subject-matter and treatment, this fourth edition of *Air Navigation and Meteorology*, a practical handbook for class study, will be particularly useful to air navigation instructors in preparing instruction sheets, which consist of syllabized subject matter handed out on duplicated sheets containing sample problems covered by the assignment.

Twenty-one chapters contain the latest standard data on air pilotage, dead reckoning and radio navigation, as well as atmosphere, wind, clouds, air masses and fronts, icing conditions, weather maps and charts, and weather forecasting. The author writes that many ground instructors and authorities were consulted to bring the revised work up to date in scope and treatment. As with previous editions, this one is well illustrated to simplify study.

Air Navigation and Meteorology, by Capt. Richard Duncan; 4th edition, The Goodheart-Willcox Company, Inc., Chicago, 1941; 290 pages, $3.00.

Book Notes

I Want a Job in Aviation, by Floyd K. Smith; Aviation Institute of Research, Chicago, 1941; 32 pages, $.35.

A guide to assist the young man desiring a place in aviation to select the position for which he is best fitted. Special emphasis has been placed on vocations in the manufacturing field of the aircraft industry.

Strategy of the Americas, by Fleming MacLiesh and Cushman Reynolds; Duell, Sloan and Pearce, Inc., New York, 1941; 247 pages, $2.50.

A survey of the strength and weakness of our hemisphere position and of the material resources and strength of the army, navy and air forces which the Americas can call upon to defend themselves or wage a successful war. Such factors as the strategy of hemisphere defense, the size of the fleets, air forces, armies, their striking range, and their advantages and limitations in the field of operations are examined in great detail.

Focus on Africa, by Richard Upjohn Light; photographs by Mary Light; American Geographical Society, New York, 1941; 228 pages, $5.00.

The author presents through the medium of aerial photographs a portrait of the African scene as it was in the winter of 1937–1938 when he made an airplane trip from Capetown to Cairo. Each group of related photographs is accompanied by a location map and a supporting text which interprets the photographs and relates the events of the flight on which they were made.

A.S.T.M. Standards on Rubber Products; Methods of Testing Specifications, prepared by Committee D-11 on Rubber Products; American Society for Testing Materials, Philadelphia; 256 pages, $1.75.

The various A.S.T.M. standard and tentative-standard methods of test and specifications pertaining to rubber products are presented in convenient form for laboratory use and reference. A bibliography on the mechanical testing of rubber is included for investigators requiring greater detail.

Civil Air Defense; A Treatise on the Protection of Civil Population against Air Attack, by Augustin M. Prentiss; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1941; 334 pages, $2.75.

An analysis of the strength and limitations of modern air power and a discussion of the various defense measures necessary for the protection of civilians from the effects of explosive and incendiary bombs and gas attacks. Methods of protection against air attack, such as the organization of air raid warning systems and construction of bomb shelters described, are based upon the best modern practice in Europe.

The Boys' Book of Model Aeroplanes, by Francis A. Collins, 4th rev. ed.; D. Appleton-Century Company, Inc., New York, 1941; 262 pages, $2.00.

Instructions for the designing and building of flying models of all types. Rules for conducting model airplane contests and the constitution and by-laws of a club are also included.

British Fighter Planes, by C. G. Grey; Faber & Faber, Ltd., London, 1941; 200 pages, 5*s*.

Development and achievements of British fighter airplanes from the earliest types to the present Hurricane, Spitfire, Tornado and Whirlwind. A chapter is devoted to American fighter planes and bombers being used by the R.A.F.

Mechanism; Fundamental Theory of the Modification and Transmission of Motion, by Stanton E. Winston; American Technical Society, Chicago, 1941; 372 pages, $3.50.

The basic principles of the three ordinary modes of transmission of motion are developed in this text which is complementary to the author's *Machine Design*. The graphic method of analysis is stressed in analyzing the relative motion of types of mechanism of each mode.

How to Draw 'Planes, by Frank A. A. Wootton; Studio Publications, Inc., New York, 1941; 64 pages, $1.00.

Suggestions for the authentic sketching of airplanes and the effective use of shading and lighting.

R.A.F.; The Story of a British Fighter Pilot, by Keith Ayling; Henry Holt and Company, Inc., New York, 1941; 332 pages, $2.50.

An account of the R.A.F., its organization, methods, pilot training courses, the day-to-day life of the pilots, the planning and practice of long bombing raids, and defensive patrols as told to the author by an R.A.F. fighter pilot.

The R.A.F. in Action; The Macmillan Company, New York, 1941; 86 pages, $2.00.

A record of the R.A.F. in the first year of the war against Germany. Many photographs are used to illustrate each branch of R.A.F. activity.

America and Total War, by Fletcher Pratt; Smith & Durrell, Inc., New York, 1941; 318 pages, $3.00.

A survey of the problems and policies related to our present national defense effort. Many revealing things are told about the German army, and our own is submitted to a searching study.

Gears and Gear-Cutting; Principles, Practice and Formulae, edited by F. J. Camm; Chemical Publishing Company, Brooklyn, N. Y., 1941; 144 pages, $2.00.

Gear design, types, functions and methods of cutting all types of gears, including spur gears, helical gears, spiral and screw gears are included in this discussion.

Library Accessions

Engineering Economics; Works Organization and Management; Book I, Elements of Industrial Organization, by T. H. Burnham and G. O. Hoskins; 5th edition, Pitman Publishing Corporation, New York, 1940; 322 pages, $4.50.

Fundamentals of industrial administration and the economic influences and factors which control production for those who wish to specialize in the administrative side of engineering practice.

Deeds That Held the Empire by Air, by L. E. O. Charlton; John Murray, London, 1940; 280 pages, 7*s.* 6*d.*

The high lights of British aviation including the achievements of military aviation in the World War of 1914–1918 and the first nine months of the war of 1939.

Fighting Planes of the World, edited by E. C. Talbot-Booth, compiled by Eric Sargent; 3rd edition, Sampson Low, Marston & Co., Ltd., London, 1939; 624 pages, 9*s.* 6*d.*

Illustrations and descriptions of the air forces and fighting aircraft of the principal countries.

Flight to Victory; An Account of the Royal Air Force in the First Year of the War, by Ronald Walker; Penguin Books, Inc., New York, 1940; 127 pages, $.25.

The part played by the Royal Air Force in the present war. The text contains many photographs and a day-by-day table of enemy and British losses for the months of August, September, October and November.

German and Italian Aircraft; How to Spot Them; Hutchinson & Co., Ltd., London, 1940; 96 pages, 1*s.*

Photographs of German and Italian airplanes in characteristic flying attitudes, together with notes on features by which each machine can be recognized.

On Guard Against Gas; An Account of the Principles of Gas Warfare and of the Steps to Be Taken by the Ordinary Citizen to Defend His Family, by H. A. Sisson; Hutchinson & Co., Ltd., London, 1938; 91 pages, 2*s.*

Methods of defense against gas warfare presented in non-technical and readable form, including some explanation of the principles involved and the reasons for the precautions recommended.

The Peril from the Air, by Malcolm Campbell; Hutchinson & Co., Ltd., London, 1937; 126 pages, 1*s.*

A warning to the British nation of the peril of German rearmament and suggestions for the protection of the civilian population against invasion from the air.

The Royal Air Force; A Concise History, by A. O. Pollard; Hutchinson & Co., Ltd., London, 1939; 276 pages, 7*s.* 6*d.*

History and activities of the Royal Air Force and the importance of the position it occupies in Britain's national life.

War in the Air; R.A.F., by James Gardner; Penguin Books, Inc., New York, 1941; 30 pages, $.25.

A picture book of military airplanes for young people.

Europe in the Melting Pot, by Vladimir de Korostovetz; Hutchinson & Co., Ltd., London, 1939; 320 pages, 10*s.* 6*d.*

A study of pre-war and post-war European politics, with particular reference to the role played by Soviet Russia in international diplomacy.

Women with Wings, by Pauline Gower; John Long, Ltd., London, 1938; 223 pages, 10*s.* 6*d.*

The story of Pauline Gower and Dorothy N. Spicer, two pioneer airline operators.

Theory of Lubrication, by Mayo Dyer Hersey; John Wiley & Sons, Inc., New York, 1938; 175 pages, $2.50.

A condensed treatment of the scientific principles of modern lubrication to assist in the solution of practical problems. It is intended for the physicist, engineer, and engineering instructor rather than the undergraduate.

Let's Fly, by Frances Norene Ahl; Christopher Publishing House, Boston, 1940; 237 pages, $2.00.

Details of a thirty-thousand-mile airplane voyage of the author throughout the lands and islands of the Pacific area.

Flying Wisdom; A Book of Practical Experiences and Their Lessons, by H. S. Broad; Sampson Low, Marston & Co., Ltd., London, 1939; 211 pages, 6*s.*

Hints on flying for the student pilot and a discussion of the trend of development in light planes.

How to Become an Air Pilot, by R. L. Preston; 7th edition, revised and enlarged, Sampson Low, Marston & Co., Ltd., London, 1939; 178 pages, 3*s.* 6*d.*

Useful general information combined with various British Government regulations and examinations for the student pilot.

Mechanics Applied to Vibrations and Balancing, by D. Laugharne Thornton; Chapman & Hall, Ltd., London, 1939; 529 pages, 36*s.*

Presentation of the general theory of vibration covering such subjects as balancing of engines, balancing of locomotives, theory of vibrations, propagation of stress in elastic materials, beams and plates, rotating shafts and disks, and a general survey.

The Causes and Forecasting of Low Ceilings and Fogs at Jacksonville Airport, by J. J. George; Eastern Air Lines, Meteorological Department, Atlanta, Georgia, 1939; 79 pages.

Methods for the classification and forecasting of fog and low ceiling based on the results of a survey of four years of hourly U.S. Weather Bureau records of weather conditions for this airport.

The Aircraft Bench Fitter, by William S. B. Townsend; 2nd edition, Pitman Publishing Corporation, New York, 1940; 75 pages, $1.50.

Useful information for the novice on the ordinary matters which a bench fitter should know—how to harden and case-harden steel, how to read drawings, how to mark out, information on tools and materials he would have to work, and instructions for soldering, welding, brazing, etc.

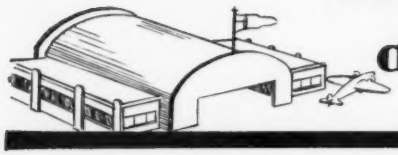
Records and Research in Engineering and Industrial Science; A Guide to the Production, Extraction, Integrating, Storekeeping, Circulation, and Translation of Technical Knowledge, by J. Edwin Holmstrom; Chapman & Hall, Ltd., London, 1940; 302 pages, 15*s.*

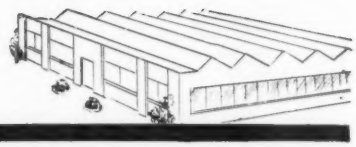
A description of the processes and organizations concerned with the collating of data to serve as a guide to the reference sources available for any particular investigation.

Conquest of Space and Time; Part Four, The Air, by Edgar B. Schieldrop; Hutchinson & Co., Ltd., London, 1940; 327 pages, 7*s.* 6*d.*

A general survey of the development of the airplane and its engine, aerodynamics and commercial aviation.

House Organs and Catalogues





Story of the Boeing B-17

Plane of the Year. In 1934 when France was pouring concrete into the Maginot line and 185 m.p.h. was good speed for a pursuit airplane, Boeing engineers planned a four-engined bomber. Many leading military strategists claimed that the craft was too large and too vulnerable to be an effective military weapon. Nevertheless, Boeing went ahead and built the Model 299 as it was called.

Current events in Ethiopia, Shanghai and the Spanish Civil War gave more ammunition to those who advocated light and medium twin-engined bombers. However, recent changes in the technique of warfare have made long-range raids against inland objectives necessary, and the four-engined bomber of the B-17 type emerged as a leading individual type. This is witnessed by Germany's hurried conversion of the commercial Focke-Wulff *Kondor* into the *Kurier*, and Britain's hasty production of the *Stirling*.

The United States is in a favorable position, having such four-engined types in production such as the Boeing B-17E, which is now being delivered in its sixth improved model. *Boeing News*, June.

Engine Catalogue

Ranger 6. A descriptive 12-page folder on the Ranger 6 in-line air-cooled engine. Ranger's commitment to in-line design is explained with a statement of the advantages of the type, such as reduced drag, increased visibility, smoothness of operation and simplicity of maintenance.

The Ranger's lubrication system and the plan for pressure cooling which allows almost even head and base temperatures on all cylinders are described. The pamphlet also provides performance graphs and specifications on powerplant. *Ranger Aircraft Engines Division.*

Speeding Maintenance at Randolph

Streamlining Night Maintenance. Capt. Norman E. Borden, Jr. The shortage of engines and spare parts and the extreme acceleration of activity at Randolph Field formerly made it difficult to keep the training craft in constant commission as the urgency of present conditions required. To solve these problems all maintenance had to be done at night, requiring the reorganization of the prevailing field maintenance system.

Previous experiments in night maintenance indicated that the mechanics suffered acute eyestrain from inadequate lighting, and that proper illumination for the hangars was in excess of the funds available for that purpose. Under the new plan, experiments in fluorescent lighting were conducted, and the results indicated that their use provided sufficient illumination for efficient work at a cost well within the allotment.

The new crew system inaugurated to handle night maintenance is described as well as some of the special tools which the officers and men designed and built chiefly from salvaged parts to accelerate work. The adoption of this system has resulted in 95 per cent of the aircraft being in commission in April as compared with 63 per cent last October. *Air Corps News Letter*, June.

Anodizing at United Aircraft

Anodizing Now Being Done Here. A description of the new anodizing equipment recently installed by the Pratt & Whitney Division of United Aircraft Corporation. It is said that formerly only Navy equipment was anodized. The aluminum on all Pratt & Whitney engines is now being treated at the plant rather than outside. *Aircraft Journal*, May 16, 1941.

Cleaners

Aviation Cleaning Handbook. The cleaning of aircraft, both as part of routine maintenance and of major overhaul, has always been recognized as an essential part of safe, efficient operation. Special cleaning agents have been developed or adapted from other industries to meet such common problems in maintenance as the routine cleaning of aircraft exteriors, of engines while dismantled, and of interiors, plugs and stripping finishes.

This 24-page booklet explains the use of these various cleaners and cleaning equipment manufactured by Magnus. Directions are given for the selection and use of cleaners for various purposes in engine, airplane and airport maintenance. *Magnus Chemical Company, Inc.*

Helicopters for the Millions

Airplanes for the Masses Predicted by Igor Sikorsky. Helicopter-type airplanes for the masses within the next two decades were predicted recently by Igor Sikorsky, speaking at a meeting of tool engineers at Hartford, Conn. Mr. Sikorsky believes that speeds of 150 m.p.h., fuel consumption of five to six gallons an hour, and lift of from nine to ten lbs. per hp., can be attained in helicopter design. He also stated that flight control can be learned in confined space, and that anyone can fly a helicopter-type airplane with perfect safety. The talk was illustrated with motion pictures of the new VS-300 helicopter. *Aircraft Journal*, May 16.

The Use of Aluminum

Aluminum in Aircraft. Intended to furnish basic information on the use and application of aluminum and its alloys in aircraft, this 104-page booklet explains the temper designations and classifications of the various types in common use.

The forms in which the metal is delivered—sheet, extruded shapes, tubing, forgings, castings, etc.—are described together with the specifications and inspection system by which the Army and Navy requisition the metal. In familiarizing the reader with airframe fabrication, the processes of cutting and blanking, various methods for forming it into parts and for heat treating, annealing, hardening, riveting, joining and machining the metal are outlined. Various methods of welding and protective finishing are also described.

Standards by which the proper alloy is selected for any particular function are given along with commonly used tables such as government specifications, radii of 90° bends in cold sheet, heat treatments and quenching time, aging data and mechanical properties. *Aluminum Company of America.*

Air Raid Shelter

Protective Construction. The first of a series of bulletins prepared by the War Department to furnish information on various phases of civilian defense. This 50-page pamphlet deals with aerial attack, weapons used, the effects of bombs and measures of defense to be taken against aerial attack. The protection of buildings and utilities is discussed and a special section on the design and construction of air raid shelters includes drawings and plans of shelters for the private family.

The introduction points out that the issuance of this bulletin is not to be taken as a signal to start work immediately on the protective structures described. It is suggested rather that responsible officials and civilian engineers give thought to methods and procedure to be followed should protective measures become necessary in the future. *Civilian Defense, Bulletin No. 1*, U.S. Government Printing Office, 1941.

Research Flight

Cosmic Ray Scientists Go Aloft in Mainliner. Brief account of a recent research flight by Dr. Arthur H. Compton and two assistants in a transport of the United Air Lines. The flight, over Chicago, represented a continuation of their studies of the cosmic ray from aloft. *United Air Lines News*, June.

Hyperventilation

Freezing on the Controls. Hyperventilation, the medical term for breathing in more air than normal, is frequently caused by emotional disturbance of the respiratory rhythm. The symptom is numbness and tingling of the extremities. If permitted to continue, the condition may result in vasomotor collapse.

This article calls attention to the dangers of hyperventilation in airplane pilots and indicates that even veteran airline personnel are not immune to the effects of it, particularly when flying on instruments or under unfavorable conditions. How to recognize the symptoms of hyperventilation and the method of circumventing it by proper breathing are explained. *What's New*, June.

Bulletins on Dowmetal

Several new bulletins in the regular series on the handling of Dowmetal have been issued recently by the Dow Chemical Company on the handling and treatment of their magnesium alloy. These bulletins discuss the crucible method for melting Dowmetal for all types of sand castings; the acid pickling of the castings when completed, and several popularly used chemical treatments for Dowmetal products; preparing them for special use, such as mild exposure; machining before painting and exposure to salt water.

The bulletins contain not only description of the process involved, but lists of the equipment and material used and, where needed, the precautionary measures required for the safe conduct of the operation. *The Dow Chemical Company.*

Fasteners

Dot Cowling Fastener. A folder furnishing a technical description of this fastener. The fastener is used for flat or curved surfaces. Its construction, installation and use are described. Schematic drawings of the fastener assembly and specifications of the various types offered are included in this presentation. *United-Carr Fastener Corp.*

Metallizing Handbook

The History, Purpose and Practice of Metallizing. A process of spraying metal onto metallic and non-metallic surfaces is described in this 54-page handbook. The process, invented in Switzerland before the last World War, was brought to the United States in 1930 and has been used as a less expensive substitute for electro-plating and for the building up of worn surfaces such as crankshafts, large pistons, etc.

Among the varied applications of this process, two are particularly suitable to aviation. One is the metallizing of exposed parts to protect them from salt water corrosion. The other is the processing of wooden patterns used in foundry work. The latter process is said to increase the life of the pattern 20 times. *Metallizing Company of America, Inc.*

How Stop Nuts Work

Using cross-section diagrams to clarify an extremely simple description, this folder outlines the use of the resilient locking-collar in the Elastic Stop Nut. The action of this collar in receiving the impression of the bolt's thread, increasing the pressure contact between the load-carrying thread surfaces, is explained. *Elastic Stop Nut Corporation.*

Casting Aluminum

Aluminum Casting Alloys and Alloys for Other Purposes. A study of the general problem of casting aluminum and its alloys, this 90-page booklet makes no specific reference to aircraft problems. However, the processes outlined are among those used in the casting of aircraft and engine parts. The choice of a proper alloy and casting process is discussed, and general aluminum foundry principles are briefed.

Melting procedure, furnace equipment, temperature measurement and fluxing are described along with the construction and composition of sand molds. Methods for finishing sand castings preparatory to final machining or finishing are recommended. Considerable space is given the problems of designing castings to higher quality at reduced costs. A list and description of the alloys available in ingot form complete the study. *Aluminum Company of America.*

Visibility . . .

See Where You're Going. Jack Strickler. An article on visibility in the modern military airplane. It is of prime importance for the military pilot to have unobstructed vision in so far as possible. In the Bell P-39 Airacobra, this "control-tower" visibility was achieved while the airplane was in the mock-up stage. After the mock-up was constructed, a motion-picture camera was placed into the position corresponding to the pilot's eye. It was moved about to suggest suitable fuselage alterations to obtain the optimum in design.

How this increased visibility makes the airplane less vulnerable to surprise attack and increases its usefulness as a military weapon is explained. The increased safety in instrument flying and landing afforded by the tricycle landing gear is also analyzed. *The Bellringer*, July.

Anti-Aircraft Measures

Patents and the Night Bomber. Although the balloon barrage is extensively used in the present war and the idea of defending cities by means of mobile anti-aircraft screens towed by aircraft is just being considered, the idea is 29 years old. Patents on this idea were issued to Joseph A. Steinmetz, a Philadelphian, in 1912. According to a feature article appearing in the Philadelphia Press on July 12 of that year, the inventor patented the idea virtually as it is being used today.

This article outlines the use of the mobile screen as a new method of warding off night bombers. It consists of 20,000 ft. of wire with a parachute on the end, lowered from a secondary line or obsolete type, such as the Vickers Wellesley. The wire carries a grapnel and explosives, towing them across the path of the raiding aircraft. The practice of mobile screen operation, the proposed equipment and the essentials of this type of anti-aircraft organization are described. *General Aircraft News*, May.

Rubber Belt Manual

Selection and Maintenance of Rubber Transmission Belts. A 12-page catalogue section written to simplify the problem of selecting the right flat rubber belting for specific driving tasks. It offers answers to common questions on belt power transmission, such as grade, width, power capacity and length of belt to use for particular purposes.

The information derived from most recent experience in the maintenance of flat rubber belting is presented in a discussion of belt dressing, cleaning, storage, static, oil and salvage; definite suggestions are offered for maintaining records on stored belts. It is said to be established that theories on leather belting, as developed through past generations, do not at all times hold true for rubber. The points at which belt theories must be modified when applied to modern non-stretching rubber belts are indicated. *The B. F. Goodrich Co.*

Airline History

Your Wings. United Air Lines' route follows the Overland Trail which for a century has been the main line of communication to the West. The covered wagons, railroads and even the earliest coast-to-coast airlines traversed this route. The major changes in UAL equipment and passenger comfort since the early days when passengers shared crowded mail pits with letters and packages are reviewed in 38 pages of picture and text showing the progress made in aircraft, personnel training maintenance, navigation and communication. *United Air Lines.*

Telecommunication Unit

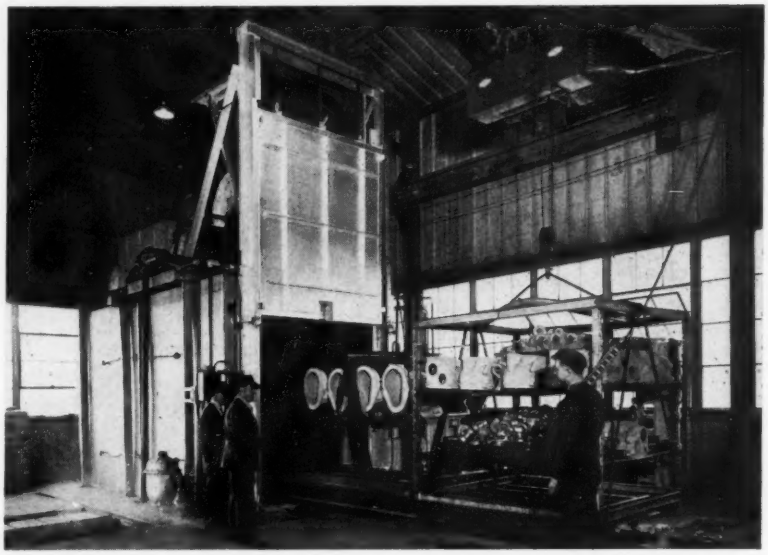
Finch Duplex Facsimile Unit. Description of the Finch Duplex Facsimile Unit, designed to transmit and receive facsimile simultaneously without interference with aural transmission or reception. The equipment, designed particularly for aircraft use, weighs 35 lbs. Its power-supply unit weighs another 15 lbs. It is equipped to send and receive sketches, written messages and maps as well as photographs, and requires no special synchronizing circuits or wires.

Besides the specifications and technical data on the unit, this booklet indicates the uses to which the telecommunication equipment may be put in both military and commercial operations. *Finch Telecommunications, Inc.*

Lockheed History

The Legend of Lockheed. John Barclay. The history of Lockheed aircraft from the post-war alliance of Jack Northrop and the Lockheed (Loughead) brothers, Allan and Malcolm. The flight of Captain George Hubert Wilkins and how it brought Lockheed airplanes to public attention is related. The company's progress and its alterations in design since that time are described.

The article recalls many of the significant names that have been connected with Lockheed and the airplanes it produced—Jack Northrop, Jerry Vultee, Herb Catlin, Frank Hawks, Wiley Post, Herb Faye and many others. Among the illustrations are two rarely seen—those of early Hall-Scott engined flying boats designed by Jack Northrop and built by the Lockheed brothers. *Lockheed Aircraftsmen,* Anniversary Issue.



A Despatch furnace, used for the solution and precipitation heat treatment of aluminum and magnesium alloy castings at the National Bronze and Aluminum Foundry Company in Cleveland. This furnace has a net charge of 10,000 lbs. of aluminum castings.

Salvage Operation

Cyclone 9, Embedded a Month in Canadian Ice. Description of a salvaging operation on a Bellanca Aircruiser embedded in solid ice. The airplane had gone through a crack which opened suddenly, into the waters of Lake Athabasca. The salavage crew waited until a deep freeze would support their equipment, and then cut and melted the airplane free from the ice. The engine, a Wright Cyclone, having been thawed out and drained of water, functioned perfectly with only the addition of a new set of spark plugs. *Trade Winds,* July.

Air Transport Proceedings

The proceedings of the Engineering and Maintenance Conference of the Air Transport Association of America held in Brownsville last February have been issued in printed form for permanent reference. Published in two parts, the 37-page record contains summaries of discussions and addresses on such subjects as plant protection, labor relations, shop safety, training and standards.

Many phases of problems involved in the overhaul and retirement of engines, propellers and other airplane components, which were discussed at the conference, are also recorded. The account of the Maintenance Session contains condensations of the discussions on airplane, propeller, instrument and landing gear maintenance as well as a discussion of the upkeep of ignition and other electrical installations.

The second part reports the Engineering Session of the meeting. Induction system icing, windshield de-icing, fire prevention, ventilating and heating, and revisions of fuel systems were among the subjects covered in this section. *Air Transport Association of America.*

British Appreciation

Air Marshal William A. Bishop, R.C.A.F. The text of a talk before the employees of Consolidated Aircraft Corporation on a recent visit to that plant. His remarks were directed toward an expression of the appreciation and thanks of the British people for the quality and quantity of production at Consolidated. He outlined the war aims of the average man and reaffirmed the promise of the British to see the war through to a successful conclusion. *Consolidator,* June.

Coordination Trainer

Preflight Reflux Trainer. The Army Corps engineering shop at Wright Field recently completed a preflight reflex trainer, a device for teaching prospective Army pilots coordination between the stick and rudder before actual training begins. The trainer, conceived and designed by Col. William C. Ocker and Maj. Carl J. Crane, consists of a cockpit suspended on a triangular frame. The frame is mounted on wheels, and is powered with a small gasoline engine. The controls of the trainer are rigged to operate in the same manner as those of a flying airplane. They are coupled with a warning horn which audibly informs the student when he overbanks or makes an error in coordination. *Air Corps News Letter*, June.

Extra Power Unit

Auxiliary Power. Description, details and specifications of a 15 hp. two-cylinder gasoline-engined auxiliary power unit for large aircraft are given in this 16-page pamphlet. Normal power output is 5 kw. with a peak load output of 7½ kw. for a five-minute period. Weight of the unit complete with sound-proof enclosure is 213 lbs. *Lawrance Engineering and Research Corporation.*

Air War Organization

The Three Commands. A résumé of the duties and activities of the Fighter, Bomber and Coastal Commands of the R.A.F., this article reviews British air combat during 1940 and furnishes comparative figures on British and enemy air losses. *Neptune*, March.

News Review

(*Continued from page 6*)

received extended leave from the line to canvass principal cities for pilots to ferry American-built bombers across the Atlantic.

June 20. Parachute troops were recognized as a permanent unit of the Army by official action of the War Department which put the Parachute Group School at Fort Benning, Georgia, on a continuing basis.

June 22. Secretary of War Henry L. Stimson issued orders consolidating all Army air activity into an autonomous organization, which will be known as the Army Air Forces.

June 22. The Civil Aeronautics Administration announced that 191 airport sites would be surveyed for possible construction or improvement under the $94,977,750 C.A.A. appropriation for the year beginning July 1.

June 25. The Army Air Corps announced plans for the procurement of 6,000 balloons for anti-aircraft barrages similar to those used for London.

June 25. Transcontinental and Western Air, Inc., announced the opening of a special division of Albuquerque, for the training of 100 qualified multi-engined airplane pilots every four weeks for transatlantic ferry service to England.

June 27. Brewster Aeronautical Corporation disclosed that its new plant in Johnsville, Pennsylvania, will be devoted exclusively to the building of the new XSB2A-1 dive bomber.

June 28. The Douglas B-19, world's largest bomber, was test flown for the first time in a flight from Clover Field to March Field by Major Stanley Umstead and Major Howard G. Bunker of the Army Air Corps.

June 28. The Twelfth Annual National Soaring Meet opened at Elmira. The successful use of gliders in the invasion of Crete focused military attention on this contest.

June 28. The Office of Production Management announced that it would recommend the construction of eight new aluminum plants with a capacity of 600,000,000 lbs. of metal annually.

June 29. The Materiel Division of the Army Air Corps revealed that on April 7, 1940, Bob Fausel, civilian test pilot for the Curtiss Wright Corp., set a new vertical dive record of 661 m.p.h. in a Curtiss P-40.

July 1. The Propeller Division of Curtiss Wright opened its fourth plant, a 400,000 sq. ft. building at Indianapolis.

July 2. Lyle Maxey set an unoffical glider altitude record of 18,200 ft. at the twelfth annual national soaring contest at Elmira. Malfunctioning of the barograph prevented the official recognition of the record.

July 2. The new Naval Air Station at Tucker's Island near Hamilton, Bermuda, was formally opened. Lieutenant Commander Robert F. Hickey will command the station.

July 3. By executive order of President Roosevelt, the plant of North American Aviation, Inc., Inglewood, California, was returned to its owners, ending government seizure exercised during the recent strike.

July 3. Orders for aircraft engines and sub-assemblies amounting to $140,000,000 were awarded to the Ford Motor Company. Pratt & Whitney 2,000 hp. engines and parts for the Consolidated B-24 bombers made up the bulk of the order.

July 4. The Chrysler Corporation announced plans to construct $42,000,000 worth of nose and center fuselage sections for medium bombers at the old Graham-Paige plant in Detroit. These parts will be used by the Glenn L. Martin Company at their new assembly plant in Omaha.

July 4. Prince George-Valentin Bibesco, pioneer pilot and president of Federation Aeronautique Internationale, died in Bucharest at the age of 60.

July 5. The Army Air Corps began receiving regular deliveries of dive bombers, as plans were completed for the formation of six dive-bombing squadrons.

July 8. U.S. Naval Forces occupied Iceland. Air Units were sent with the occupying expedition.

July 8. Negotiations began between defense officials and the International Agricultural Corp. for the production of magnesium in a plan to increase output to 400,000,000 lbs. a year. The current rate is about 30,000,000 lbs. annually.

July 9. Col. Robert Olds, chief of the newly formed Army Air Corps Ferry Command, received the bronze trophy and medal of the International League of Aviators (Federation Aeronatique Internationale) for his work in commanding the Latin-American good-will flights. Formations of Boeing B-17 bombers took part in these missions.

July 10. The Office of Production Management announced that 1,476 military aircraft had been produced during June, an all-time high for a single month. This total, despite delays caused by strikes, was 142 units ahead of the May record.

July 10. Leland Jamieson, Eastern Air Lines pilot and widely known novelist and magazine writer, died after a long illness at Jacksonville, Florida. His age was 37.

July 10. F. C. Kroeger, vice-president of General Motors and general manager of the Allison Division, announced the receipt of an additional contract for Allison engines from the War Department. The contract involved approximately $50,000,000.

5

ALUMINUM, DEFENSE, AND YOU

ALCOA

GENTLEMEN, BEHOLD A PARADOX!

ONE POUND OF CIVILIAN ALUMINUM becomes one pound of Defense Aluminum by the simple process of writing the magic symbols AA to A-10 on certain pieces of paper.

THIS DEFENSE ALUMINUM we are making is not special aluminum; it is just good old Alcoa Aluminum in especially *large* quantities.

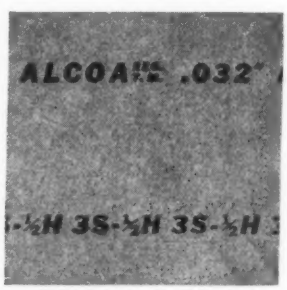
HOW LARGE? Each pound of civilian aluminum shipped in the average month of 1930-38 has been multiplied into almost four pounds a month for defense. And this was possible only because we started to spend over $200,000,000 for expansion long before today's needs became generally recognized.

The 2400-foot-long rolling mill being constructed at Alcoa, Tennessee. This new 57-acre plant will bring our sheet rolling capacity up to more than 33,000,000 pounds per month.

HERE'S THE PARADOX: Civilian Aluminum is exactly what we are making; Defense Aluminum is what we are shipping—and a great deal of it.

DEFENSE DOES NOT ASK FOR different aluminum; it could not ask for better aluminum. It asks only more of the same. We are happy to report that defense industries asked for and got from us something like twenty million pounds *more* last month than were forecast in schedules set up six months ago.

DEFENSE ORDERS specify aluminum in the old familiar way, using the same train of tried and true Alcoa Alloy numbers—2S-3S-11S-17S-24S-52S-195-356, and all the rest. They do the same things superlatively well, for Defense, that they have been doing for you.



WHEN ALUMINUM COMES BACK into civilian use, it is going to be very like switching this crack train of Alloys of Alcoa Aluminum right back on your track.

BUT THERE WILL BE SOME SURPRISES aboard. New techniques, new economies, are being sought, found, and already put into use by our busier-than-ever researchers. Probably there will be a new alloy or two. Certainly, there will be many new ways to use the old ones, profitably.

ALUMINUM COMPANY OF AMERICA

From the Industry

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Review.

Civil Aeronautics Administration

Airworthiness requirements for aircraft engines have been changed to require more exhaustive tests, the Civil Aeronautics Board stated in announcing amendment of Part 13 of the Civil Air Regulations.

The outstanding single change brought about by the amendment provides that each type of engine manufactured must undergo 150 hours of testing before it can be declared airworthy. Heretofore 50 hours have been sufficient. In addition to this increase in the duration of the tests, the procedures and conditions under which tests are made have been redefined.

The amendment also specifies that manufacturers supply purchasers of engines with instruction books covering installation, operation, servicing, maintenance, repair and overhaul of the engines.

Appointment of the C.A.A.'s first 50 aircraft inspection representatives to facilitate clearance of civil airplanes for flight after they have been repaired, was announced by Acting Administrator of Civil Aeronautics Charles I. Stanton.

The inspection representatives will serve in inspecting aircraft substantially the same rôle that flight examiners have served in the testing of pilots; they will provide more points throughout the country at which airplanes which have undergone repairs can get a prompt inspection for use.

Creation of flight examiners was made necessary by the large scale on which the C.A.A. pilot training program was turning out candidates for licenses—the rate last year being 13,000 to 14,000 every four months. This volume far exceeded the number which could be tested promptly by the C.A.A.'s limited staff of inspectors, so the inspectors were authorized to pick out and designate as examiners several hundred highly qualified instructors, usually heads of flight schools whose verdict as to the competency of a student pilot could be relied upon. The examiners serve without pay and regular C.A.A. inspectors spot-check candidates to make certain C.A.A. standards are being maintained.

The use of flight examiners was first fostered more than a year ago by Robert H. Hinckley, now Assistant Secretary of Commerce. According to the former Chairman of the Civil Aeronautics Authority, "Civil aircraft have become too numerous for our limited staff to inspect promptly. The result has been that on many occasions, planes have been kept on the ground awaiting the arrival of an inspector. We want this situation reduced to an absolute minimum.

"These aircraft inspection representatives signify our first substantial trial of this plan in the field of equipment. If the plan works satisfactorily, it will be expanded. The inspection representatives selected by our regular inspectors are technicians of known ability and integrity who are engaged full-time in the business of servicing aircraft. Our inspectors, of course, reserve the right to double-check the inspection representatives' verdicts whenever they desire. The whole idea is to speed up clearances."

To standardize the numbering and marking of airport runways and landing strips, the C.A.A. has developed a simplified system which it is urging for national adoption. Runways under this system will be numbered according to the reciprocal of the magnetic bearing, a change which will eliminate much confusion for pilots and standardize airport traffic control throughout the nation.

For example, a runway lying north and south magnetic would carry the number 36 on the south end and 18 on the north end, representing 360 and 180 which are the magnetic compass courses when flying magnetic north and south. Thus a pilot approaching a field, and told by radio to use runway number 36, would line up his plane with the runway by heading 360° while some distance away and carry out his landing without having to circle. Conversely, if he were to land toward the south, he would put the plane on a 180° heading on final approach to the airport.

A runway lying east and west would have 9, representing 90 on the west end, and 27, representing 270, on the east end. In all cases, the zero is dropped so as to use no more than two numbers. The nearest even 10-degree number is used so that a runway lying 217 degrees would be numbered 22, and one lying 304 would be 30. The numbers are 50 feet high and 25 feet wide.

Where parallel runways are to be used, the runway to the right of the approaching pilot will be the one used for landing and the letter "R" will be printed under the number.

Under the old system, runways have been numbered numerically, with the runway nearest to true north numbered 1, and the others numbered consecutively in a counter-clockwise direction. Thus, when a new runway was added, it was frequently necessary to change the numbers of all runways. In this case, too, the pilot had to circle the field to locate the number of the runway on which he was instructed to land and the tower operator had to give the bearing of the runway in his radio directions to the approaching pilot. The new system will greatly reduce the load on the airport tower transmitters, since it requires less conversation.

Aeronautical Chamber of Commerce of America

The problem of safer landings for the high-speed airplanes of modern warfare has been solved in the research and engineering departments of American aircraft factories.

The answer, according to the Aviation News Committee, lies in the tricycle landing gear, pioneered in this country and highly praised by British pilots who have found American-built warplanes thus equipped ideal for operations on and off the limited landing areas prescribed by the European war.

...Two of the Many Ways in which BAKELITE Plastics are Serving the Aircraft Industry

The demand for greater speed in aircraft manufacture and performance is matched by the need for increased durability and operating efficiency. These requirements are met by BAKELITE Plastics which, because of their great variety and versatility, are serving the Aircraft Industry in numerous ways. Two contrasting examples are BAKELITE Resins for protective finishes, and Laminating Varnishes for the production of laminated plastics.

Drying time for surface coatings has been speeded up, in some instances, to *less than one minute,* by using finishes formulated with BAKELITE Dispersion Resins. These finishes assure great durability, because they will not blister, wrinkle, surface dry or "case harden." They do not become brittle with age. They also possess greater resistance to moisture and have unusual sealing and filling properties.

The development of luminescent laminated plastics for such applications as instrument panels and dials makes for greater safety in night flying. The fluorescent and phosphorescent markings are incorporated in the laminated plastic structure. They cannot be chipped or rubbed off and are effectively protected against moisture and wear. The plastic panels and dials are unaffected by grease and solvents. They are readily cleaned by wiping with a damp cloth.

For detailed information on the many types of BAKELITE Plastics, write for copies of Booklet 46M, "Bakelite Molding Plastics," and 46P, "New Paths to Profits." Also, employ the services of the Bakelite Engineering Advisory Staff to help you solve your plastics problems.

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PLASTICS HEADQUARTERS

The engineering departments of several aircraft companies contributed long hours of research to development of the tricycle gear in its modern form. Some of the world's earliest airplanes utilized the three-wheel type of gear, but during the World War the trend swung to the two-wheel type. It was not until such organizations as Douglas, Bell, Consolidated, Lockheed, North American and Martin began equipping their airplanes with a tricycle gear designed for modern craft that it returned to popularity.

Protracted studies were made with landing gear test vehicles which included weight, balance, tread and wheelbase dimensions similar to those proposed for the actual airplane. Many of these tests were run up as high as 70 m.p.h. over all sorts of terrain, ranging from concrete runways to rough country sod.

In discussing the tricycle as used on the Airacobra, F. P. Bassett, assistant project engineer of the Bell plant, said:

"One of the outstanding advantages obtained by the use of the tricycle gear is that landing technique is greatly simplified for pilots of limited experience. All landings are much safer since it is not necessary to stall the airplane. There is now very little excuse for overshooting the field since higher landing speeds are permissible, and it is impossible to nose over due to excessive brake application at any speed.

"When rolling, the plane does not 'porpoise' due to rough ground or excess speed. Ground looping is eliminated. Stability while rolling is not seriously affected, even if a tire should blow out or a brake become locked. Other obvious advantages are the added safety obtained in case of landings at night or in poor visibility."

Curtiss-Wright Corporation

The first of a large number of newly completed advanced combat trainers, the Curtiss SNC-1 type, have been delivered to the U.S. Navy by the St. Louis plant of Curtiss-Wright Corporation's Airplane Division, for the training of combat pilots. The new trainer is a two-place, full-cantilever, low-wing monoplane of all-metal construction. It is powered with a nine-cylinder 450 hp. Wright Whirlwind engine, is equipped with retractable landing gear for increased speed and maneuverability and has split-type flaps for reducing landing speed.

The new type may be adapted to all kinds of training activities in naval aviation including gunnery, bombing and instrument flying. It can be equipped with machine guns and light bombs for training pilots under combat conditions. It has provisions for radio transmitter and receiver, and also oxygen facilities for combat training at high altitudes. In a national emergency, it would serve as a first class auxiliary defense unit.

The front cockpit is reserved for the pilot and contains complete flight instruments, power plant and armament controls. The rear cockpit is equipped for use by an instructor, gunner or observer; and all flight and power-plant controls of the front cockpit are duplicated.

Douglas Aircraft Company, Inc.

The War Department has authorized release of information on the Douglas A-24 dive bomber, indicating some of the changes in Air Corps operations which have been incorporated in the light of recent military developments. The A-24 is similar to the model SBD-3 which the company has been delivering to the Navy. Certain adjustments have been made to accommodate Army armament and radio equipment and to adapt the A-24 to land instead of carrier operations.

The Army's new dive bomber is a single-engined two-place low-wing monoplane equipped with retractable landing gear. It is powered by a Wright R-1820-F 52 engine and is equipped with a three-bladed propeller.

Classified as a light bombardment type, the A-24 will supplement the Air Corps development of a rounded bombardment force to include all types of aircraft for engaging any potential enemy. Continued emphasis is placed on the importance of heavy and medium bombers for long-range operations and of light bombers, such as the A-20 and A-24, for attack purposes and special missions.

E. I. du Pont de Nemours and Company

Explosive rivets made by Du Pont may prove an important factor in accelerating American aircraft production and simplifying design. The rivet is of a new type with high explosive secreted in a cavity at the end of the shank. Heat, applied to the rivet head by an electric gun, detonates the charge. The explosion expands the charged end of the shank, thus forming a "blind" head and setting the rivet.

The whole operation is performed from one side with greater ease than is possible by any mechanical means now being used in aircraft factories. Engineers estimate that from 800 fastening points in an all-metal pursuit airplane to as many as 10,000 on the largest all-metal bomber are accessible from only one side. This has been one of the most troublesome factors in the mass production of military aircraft.

Using the best mechanical methods now available, a skilled worker can only set about two to four blind fasteners per minute after they have been placed in the holes. The equipment is comparatively costly. The new rivets may be installed by one workman at a rate of 15 to 20 rivets per minute, once they are in place. The riveting iron weighs less then five pounds. The rivets themselves weigh only a fourth as much as generally used blind fasteners of mechanical design.

So finely has the explosive charge been controlled that the expansion it effects may be held within limits of 0.002 in. All-metal design, pre-eminently employing light metal, requires between 40,000 and 500,000 rivets per plane according to its size. The trend is to increase the number as airplanes grow larger. For example the recently completed Douglas B-19 is said to have over 3,000,000 rivets.

Many kinds of mechanical blind rivets have been developed, but in general they have compared unfavorably with the "bucked" rivet in physical and structural properties, besides being difficult to install economically. So serious has been this difficulty that it has influenced airplane design through the efforts of designers to avoid blind fasteners.

The new rivets now being manufactured are of an aluminum alloy. Of varying diameters and sizes to meet structural requirements, they are of modified brazier head and countersunk types, the latter permitting the flush riveting required by modern aircraft.

The rivets are installed in the age-hardened condition and do not require refrigeration after heat treatment as is necessary with solid rivets of the same alloy. In shear and tension, these rivets develop values which are approximately the equivalent of driven rivets in common use.

The B. F. Goodrich Company

A new lightweight air hose so flexible that the $^1/_2$-in. size can be bent to a three-inch radius without collapsing or cutting off the air supply is announced by The B. F. Goodrich Company.

The hose has been designed so that strength and efficiency are combined with minimum weight and ease of handling and should have particular appeal to shop men handling pneumatic tools. Of two braid construction, the hose can easily withstand working pressures of from 80 to 125 pounds.

Compound of the tube is of oil resistant rubber, with excellent heat-resisting characteristics. The tube does not flake or clog tools. Yarn reinforcement affords a safety factor of more than five to one under a working pressure of 125

BG ON AN AVIATION SPARK PLUG IS THE BEST

GUARANTEE OF BETTER PERFORMANCE FROM

AVIATION ENGINES ...LARGE OR SMALL

THE BG CORPORATION

Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders

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pounds, while the insulation has been especially developed to assist in flexibility and resistance to kinking.

Three new Vibro-Insulators, the devices of rubber and metal which decrease vibration and noise in machinery of many types, are announced by The B. F. Goodrich Company, and listed as Types 14, 33 and 36. They are for general application.

Type 14 is recommended for a load in vertical shear of 80 lbs. per sq.in., deflection in shear of one in. at a loading of 80 lbs., and minimum disturbing frequency at this deflection 470 per minute. This type also is supplied with the rubber in compression, by placing the metals in a horizontal position. The maximum recommended load under compression is 250 lbs. per in., deflection at that loading of $^5/_{16}$ in. and the minimum disturbing frequency at that deflection 850 per minute.

In Type 33 the rubber is applied only in compression, with the maximum loading 150 lbs. and deflection at that point $^5/_{32}$ in., with the minimum disturbing frequency at that deflection 1,200 per minute.

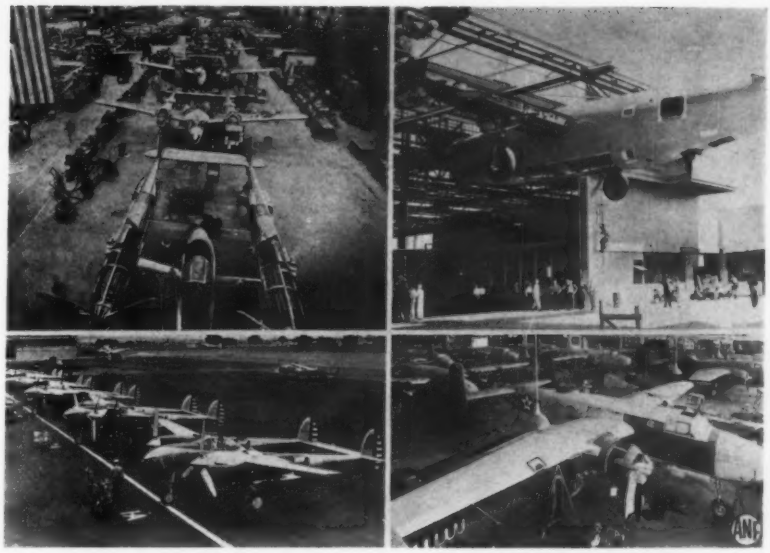
Type 36 is best adapted to work with the rubber in compression, although it can also be applied in shear. With 35 and 50 durometer hardness loading beyond 20 per cent of the rubber thickness, or 0.175 in., is not recommended. Under this load the minimum disturbing frequency is 1,250 per minute and the load necessary to deflect 35 durometer mounting is 100 lbs. and for 50 durometer mounting 85 lbs. These are maximum load limits with lower loads recommended where possible, especially where disturbing frequencies are greater than 1,250.

Kollsman Division of Square D Company

A new type of Kollsman Direction Indicator, with the dial on a 45° angle, intended for mounting at the lower part of the instrument panel, has recently been developed for the Navy by Kollsman Division of Square D Company.

A need for this type of Direction Indicator Compass appeared recently when the Navy found it necessary to move the compass from its regular place atop the instrument panel. Commercially, the new Direction Indicator may meet a similar need when circumstances will not permit mounting the compass in its regular place.

The angle type model has all the features of the Kollsman Direction Indicator with the vertical dial. This includes the stationary compass-rose dial with the movable pointer and the reference index which can be set to any desired heading, making it only necessary to match pointers when following a course.



The pace of U.S. aircraft production increases, according to figures and photos issued by the Aeronautical Chamber of Commerce of America. The upper left picture shows final assembly of Lockheed P-38s. Lower left, the same interceptors, ready for delivery. Upper right, the fuselage of a Consolidated B-24 entering the factory on the roof-high monorail system. Lower right, the assembly of North American B-25 medium bombers.

Luscombe Airplane Corporation

Designed and produced especially for the Civilian Pilot Training Program is the new Luscombe Silvaire, Model 8D-1, a two-place all-metal side-by-side high-wing monoplane with 1,310 lbs. gross weight. Powered by a 75 hp. dual ignition Continental injector engine, the new model has two 12-gallon fuel tanks in the wings giving it a range of 500 miles at its rated cruising speed of 110 m.p.h.

General construction details and appearance of the new plane are similar to the familiar Luscombe airplanes now in use. Fuselage is full monocoque of riveted Alclad sheets. The strut braced wings have Dural extruded spars and ribs, covered by Grade A Flightex fabric. Tail surfaces are full cantilever with no external bracing.

Standard equipment includes brakes, steerable tailwheel, compensated compass, trim tab, formed Vinylite windshield, full cabin upholstery, carpet, propeller spinner, instrument panel, dual ignition and fuel injector.

Special provision is made for the installation of two-way radio and full blind-flying instruments. Because of its economical operation, high useful load of 600 lbs., high cruising speed and long range, this new Silvaire is of special interest to operators engaged in the cross-country phase of the new C.P.T.P. secondary course.

Moraine Products Division

Representing what is described as a new technology in control of filtration and flow of liquids and gases, a porous metal product known as "Porex" has just been introduced by Moraine Products Division of General Motors Corporation. Porex has two principal functions which are to remove foreign materials from fluid, such as oil, and to alter the characteristics of gases by diffusion, reducing pressures and controlling flow rates. It is manufactured from powdered metal subjected to a series of processing operations.

Applications for Porex, the announcement states, are found in almost any appliance or piece of industrial equipment involving the flow of gases or liquids. These uses are found in pumps, refrigerators, fuel lines, lubricating systems, oil burners, evaporators, absorbers, paint sprayers, premixed gas burners and other devices.

Among its advantages, according to Moraine Products engineers, are its physical characteristics, such as chemical composition, structure, porosity, strength and ductility, which may be varied within certain limits to suit specific applications. Similar variations may be accomplished in its size and shape. Standard shapes now available are disks, sheets, cylinders and truncated cones; special shapes are also obtainable.

One important and unique feature of the material is its ability to be bonded to steel and copper. In this way, it can be made an integral part of solid metal

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NOW GIVES YOU DOUGLAS SERVICE

ANDS AND WINGS ACROSS THE WORLD'S FRIENDLIEST BORDER

North of Boston to Montreal and points in Maine, Northeast Airlines now offers the same Douglas luxury travel that distinguishes America's major airlines. A fleet of new 24-passenger Douglas transports enables Northeast to give the utmost in speed and comfort—whether you are business bound or pleasure bent. Douglas Aircraft Co. Inc., Santa Monica, California

DOUGLAS

FIRST AROUND THE WORLD *first* FIRST IN AIRLINE SERVICE

Northeast Airlines helps speed defense by expediting travel between New England, arsenal of democracy, and Canada—at war.

which may be machined, ground, bored, threaded or processed for individual requirements.

Northrop Aircraft, Inc.

According to releases from Northrop Aircraft, Inc., significant importance is attached to experimentation and research even in a day when the keynote of the industry is volume. Symbolic of the research work being done at the Northrop plant is the wind tunnel adjacent to the main factory building where models of the "airplane of the future" are daily undergoing tests.

The Northrop tunnel is one of the largest owned by a private manufacturer in the United States. Of the same size as the tunnel at the Guggenheim Aeronautics Laboratory of the California Institute of Technology, Pasadena, and the one at the University of Washington, Seattle, it was designed by the Northrop engineering department assisted by Dr. Th. von Kármán of the California Institute of Technology.

The tunnel is of the return type, with a testing wind velocity of 150 m.p.h. with present power. The tunnel is designed for much higher pressures than will be used at the present time and by simply adding more power can develop greater testing speeds if they are desired at a later date. The largest section of the tunnel is $35 \times 22\frac{1}{2}$ ft. with the average size $22\frac{1}{2}$ ft. in diameter narrowing to a 10-ft. throat in which the model is suspended.

The size of the tunnel was chosen to allow the use of the same models in check tests at the Pasadena or Seattle tunnels. The testing speed of the Northrop tunnel is slightly lower than that ordinarily used at Pasadena.

The model is suspended in the tunnel by a method of rigging similar to that used in the tunnel at the University of Washington. This method of suspension permits tests and measurements of lift, drag, side-force, pitch, yaw and rolling moments at the same time.

Forces are measured on six Toledo scales simultaneously from one position by the operator who can lock the scales to get his reading at one time if he desires. Changes in pitch and yaw settings during the test run can be made without shutting down power or removing the model from the tunnel. The ease with which the model can be mounted and the rapidity with which test data can be recorded make this an ideal rigging system.

The models to be used in this tunnel are constructed largely of laminated hardwood, usually mahogany, with various fittings and control surfaces made of metal. They are very accurately and carefully shaped to scale, painted and rubbed down to as high a polish as possible.

Ohmite Manufacturing Company

A $2\frac{1}{2}$ meter band R.F. plate choke, adaptable to transcievers and $2\frac{1}{2}$ meter mobile transmitters, has been added to the series manufactured by the Ohmite Manufacturing Company of Chicago. The new plate is a single layer wound on a low power factor steatite tube, the winding being covered with a moisture-resistant insulating material. With this type of construction, there is no possibility of the winding collapsing under operating or overload currents.

Because of the single-layer winding, the voltage differential between adjacent turns is low and the possibility of breakdowns between turns is minimized. The chokes are designed so that no portion can resonate independently to cause energy absorption or harmonic frequencies. The new Z-O R.F. plate choke is $1\frac{3}{4}$ in. long and has a tube diameter of $\frac{1}{4}$ in.

Piper Aircraft Corporation

The completion of the second army maneuvers in Tennessee June 26 brought closer to reality the use of light airplanes for military purposes. The recent large-scale maneuvers of the Second Army saw a fleet of Piper Cubs in action for the first time in simulated war conditions, and according to recommendations by high ranking army officers their performance has indicated possibilities for future use.

Seven specially equipped Piper Cub Trainers participated in the three weeks' maneuvers. T. I. Case, Piper factory representative who has been active in promoting military interest in Piper Cubs for the past six months, was in charge of the first official tests conducted by the army with light commercial airplanes. The Piper Cubs used were standard Trainers powered with Continental 65 hp. engines. They were equipped with special radio equipment which included receivers, and transmitters on army frequency channels.

During the maneuvers these airplanes were used for direction of artillery fire, liaison work in directing troop movement and courier service. The ability of the Cubs to fly slowly and steadily made possible the accurate direction of gun fire on the Jake's Mountain range in the heart of the Tennessee Mountains.

Direction was accomplished by use of two-way radio with an artillery officer occupying the rear seat of the Cub flown by factory pilots. During these operations, the Cubs operated from a clearing in the woods 298 paces long. Especially designed high performance army observation planes with five times the horsepower had difficulty operating from the same field which was surrounded by high trees and hills.

This latter fact was one of the deciding factors in an official decision to recommend light aircraft for this type of use according to Lieut. Col. Edwin G. Wells, who stated that the Cubs "can fly lower and slower than anything we've got, thus enabling the observer to see more than he could several thousand feet up and flying fast. Its maneuverability allows the plane to land in almost any field near the troops its crew is directing."

The low cost was also emphasized by Col. Wells who said, "not only can we turn out about 15 of these for the price of a single O-49 (current army observation ship) but it is so easy to handle that a pilot with little training can operate it successfully."

Artillery officers generally expressed the sentiment that they would prefer a large reserve of the cheaper light airplanes than a small number of the large and more expensive O-49's now available. In addition to these possibilities Col. Wells stated:

"The airplane can be used as a means of securing enemy information in the immediate vicinity of the front lines and we can also move our guns into positions against tank attacks more quickly than the tanks can move into position for attack."

Throughout the maneuvers officers and general staff members were impressed with the ability of the Cubs to land and take off from improvised fields and at times highways were used for this purpose. During their missions of carrying messages, transporting officers, and reporting enemy action, 102 separate pastures, roads, and hay fields were used by their pilots.

Wright Aeronautical Corporation

The initial flight of the Douglas B-19 marks the first time that engines totaling 8,000 hp. have ever been flown in one airplane. The largest airplane built to date is powered by four 18-cylinder Wright Cyclone engines, giving it power that is 25 to 50 per cent greater than any other bomber in current use, according to the Wright Aeronautical Corporation, builders of the engines.

In contrast to the power available in the Douglas B-19, the other multi-engined bombers of today have from 4,000 to 4,800 hp. available at take-off. In the commercial field the largest aircraft in service are the trans-oceanic Clippers of Pan American Airways. They have a total of 6,400 hp. from four Cyclone 14-cylinder engines of 1,600 hp. each.

Oddly enough, the almost forgotten

(Continued on page 59)

Experimental

Some 155 million years ago nature turned aviation designer and brought out a few experimental "ships" that would make even the wildest of freak designs look conservative by contrast. These forerunners of the birds, known as pterodactyls, had reasonably efficient wings; but, as we can see from their muscle arrangement, they were hopelessly underpowered. Their slow, reptilian muscles were not equal to the task of getting them off the ground readily, and it is more than likely they had to climb a tree or cliff in order to take off. So eventually Dame Nature charged them off as experimental and turned to higher-powered forms of aerial life.

For flight, whether animal or man-made, is basically linked to power. Through steady improvements in fuels and engines, aviation engineers have in a few short years paralleled nature's progress of the ages. And today the need for more and more power from each pound of engine, each gallon of fuel, becomes increasingly urgent.

It is to assist in the acceleration of this progress that the engineers of the Ethyl Gasoline Corporation work in close cooperation with aviation technologists. Already a program of continuous research has developed a great deal of useful data. Some of this information is immediately applicable. Much of it will be of greatest value in the days to come. All of it is dedicated to the proposition that the progressive evolution of American aviation shall never cease.

ETHYL

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ETHYL GASOLINE CORPORATION, *manufacturer of anti-knock fluids used by oil companies to improve gasoline*

Air Freight and Express

A bibliography giving references for research in this specialized field. Revised and brought up-to-date from the fifty volume Bibliography of Aeronautics compiled and published with the cooperation of the Work Projects Administration from the Aeronautical Index of the I.Ae.S.

Now that the air transportation industry is well beyond the pioneering stage, various branches of our air industry are considering the great possibilities offered by the transportation of freight by air. The neglect of air freight in this country has been occasioned by perhaps too rapid a development of the air transportation industry which has focused its attention on meeting the demands of passenger and mail traffic.

The airplane offers a decided advantage in time over other means of travel, and the present defense program has made manufacturers realize the advantage of transporting cargo by air. Many plants manufacturing vital parts are relying heavily upon air transportation to avoid bottlenecks in production. As time becomes a more critical factor, air freight will assume a position of still greater significance. Carrying of air freight is a contribution which the airplane is making to national defense and, as a result of the increasing use of the airplane for shipping heavy freight, it may be anticipated that within the near future, and certainly upon the termination of the present war, the transportation of goods by air will become another great industry.

Shipping of freight by airplane is not new. On November 7, 1910, the first shipment of cargo by air, consisting of five bolts of silk weighing approximately fifty pounds and valued at $1,000, was flown from Dayton to Columbus, a distance of sixty-five miles, in a skeleton-framed Wright biplane piloted by Phil Parmelee. The trip took seventy-one minutes, and the course for part of the way was marked by a large white streamer waved from the back of a Gig Four Train.

Airplane delivery of merchandise was again introduced on March 12, 1919, when a consignment of goods from the Lord & Taylor Company was flown from the store's sub-station at Garden City to the home of C. R. Shipley of Mount Vernon, New York, in less than one hour. On this trip 250 pounds of merchandise were carried in a Curtiss biplane JN-4 piloted by Roland Rohlfs, experimental pilot for the Curtiss Company. Today, department stores are delivering articles to customers hundreds of miles away a few hours after receiving their orders. The variety of department store items being sent across the nation's airways is surprising.

Airplanes are the moving vans of Canada's northland beyond the railroads, carrying everything from eggs to mining equipment and motor boats. Entire mining towns have been transported from the end of rail and water facilities into the interior. In Central America the world's largest freight-carrying airline, T.A.C.A., derives most of its revenue from hauling freight, and it has always operated at a profit. This line has capitalized on the virtual lack of other means of transportation throughout Central America. Recently a specially built Lockheed 14 carried a 6,000 lb. rock crusher casting, the heaviest load ever carried by air in Central America, from a seaport city to a mountain mining camp. This airplane had a removable freight hatch in its side and the roof of the cabin raised to give inside clearance where the wing spar crosses the cabin. In contrast, the United States has virtually no specially built cargo airplanes, and the airlines can only offer the shipper air express which is controlled by the Railway Express Agency through contracts with the major airlines.

The Railway Express Agency, then known as the American Railway Express, undertook its first major experiment in carrying shipments by air in 1919 when a British Handley-Page plane was sent from Mitchel Field, Long Island, on a flight to Chicago with a load of cargo. The airplane was forced down by head winds at Mount Jewett, Pennsylvania, after completing about one-half of its journey.

The first regular air express service in the United States was inaugurated on September 1, 1927, when the country's major airlines joined with the Railway Express Agency to start a nation-wide air-railway express service. It started operations over 4,450 miles of airlines and averaged forty-three shipments a day. In 1928, the first full year of operation, 17,006 shipments, weighing approximately thirty-two tons, were carried by air express. By 1936 this plan put air express on a door-to-door, pick-up-and-delivery basis in 215 cities in the United States and Canada and in thirty-two foreign countries and colonies. With steadily increasing appreciation of its possibilities, American industry shipped its goods by air; and, in 1936, 465,727 shipments, weighing 1,866 tons, were carried. During this period, the only big airline outside the Railway Express Agency fold was Transcontinental & Western Air, who operated its General Air Express Division.

Transcontinental & Western Air entered the air express field in 1931 and made arrangements with Postal Telegraph for pick-up-and-delivery service. This arrangement proved very successful and in July 1932 the independent companies united with T.W.A. and Postal Telegraph to form an association known as General Air Express. A period of competition started between the two systems on August 8, 1932, when General Air Express issued a rate schedule considerably below the Railway Express Agency rates. At first, General Air Express led in revenue but gradually began to fall behind Railway Express Agency.

In 1935 the Railway Express Agency announced the signing of contracts with twenty airlines. This unification of air express included all major airlines with the exception of T.W.A. The latter signed a contract with Railway Express Agency on September 1, 1937, exactly ten years after the Railway Express Agency started its Air Express Division. With the acquisition of the former T.W.A. subsidiary air express unit, the Air Express Division of the Railway Express Agency was able to offer shippers a unified air express service over the entire airline system of this country. On the first day of operation, 1,666 shipments of express were flown 200,116 miles over 30,160 miles of domestic airways. It is interesting to note that while unification was thought to be the final solution of all air express problems, actually the rate of growth of air express fell off after the first year.

Today the Railway Express Agency has contracts to handle the express of seventeen major airlines, flying on an average of 319,000 miles daily, carry air express on 45,000 miles of airways covering all sections of the United States. It also acts as express agent in the United States for Pan-American Airways and ships express over this system to the Caribbean, Central and South America, Alaska, Pacific Islands, and the Orient.

The total shipments made by the R.E.A. since 1935 are as follows:

TABLE 1

Year	Shipments	Tons
1935	200,926	770
1936	465,727	1,866
1937	658,917	2,146
1938	716,889	2,371
1939	870,806	2,925
1940	1,978,189	3,850

Last year shipments passed the one million mark for the first time in the thirteen-year history of air express. Shipments for the first quarter of this year increased 27 per cent over shipments for the corresponding quarter of last year. Gross revenue from nation-wide air express in May 1941 increased 46.00 per cent over May 1940. Shipments for the month of May totaled 112,089, an increase of 26.5 per cent over

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the corresponding month in 1940. Increase in route mileage, frequency of service, and use of air express in the National Defense Program accounts for this increase. An increase of almost 40 per cent in the weight of loads carried in the first part of this year indicates that more heavy machine parts are being sent by air.

The continual surging forward of domestic air express in this country can be clearly seen from a review of C.A.A. statistics given in Table 2.

While the use of air express is continually increasing in this country, its total daily volume is very small. With the exception of the Air Freight Division operated by the Army Air Corps, there is practically no transportation of heavy freight in this country. The U.S. Army Air Corps has for some years been interested in the development of an air transportation system of its own and has set up the Tenth Transportation Group with operation headquarters at Wright Field. The Air Corps is gradually shipping more and more of its equipment to various army air bases by air in order to develop a system which, in time of emergency, could replace ground transportation facilities which might be disrupted. Although in January 1939 only eight airplanes were in service, by the end of the year this Air Corps unit carried 50 per cent more ton-miles than all the domestic airlines combined. Last year seven squadrons, consisting of between fifty and sixty especially equipped load carrying airplanes, transported over two million ton-miles of engines, propellers, parts, and supplies. The manufacture of huge bombing planes capable of carrying heavy loads under all weather conditions and the accomplishments of the Air Freight Division of the Air Corps indicate the possibilities of transportation of cargo by air.

TABLE 2

	Express Carried		Express Revenue			Total Revenue	
Year	Lbs.	Ton-Miles	Dollars	% of Total Revenue	% Increase over Previous Year	Dollars	% Increase over Previous Year
1936	6,958,777	1,860,809	804,806.68	2.52	...	31,916,117.20	...
1937	7,127,369	2,156,070	1,200,583.87	3.24	49.18	37,109,157.03	16.27
1938	7,335,967	2,173,706	1,215,459.91	3.03	12.31	40,070,694,40	7.98
1939	9,514,299	2,705,614	1,437,748.70	3.04	18.28	47,319,892.04	18.09
1940	12,506,176	3,469,485	2,076,413.00	2.74	44.42	75,840,577.00	60.27

It has long been known that the principal source of profits of railroad and steamship companies are derived from freight and express traffic. The airlines consider the carrying of freight of incidental importance and operate their airplanes to obtain revenue from their mail contracts and passenger traffic. Reports show that although the transportation of freight and express by air is increasing at a greater rate than passenger transportation, less than five per cent of the airlines' total revenue is obtained from carrying freight and express. This operation policy is in direct contrast to the practice of other systems of transportation, and the future of air transportation is indeed promising if one assumes that in the air, as well as on the ground, the carrying of cargo can bring a greater revenue volume than passenger traffic.

The vital part which the air transportation industry is playing in the acceleration of defense shipments, as shown in the increasing growth of air express service in recent months, should be a go-ahead signal to air freight. But several changes in airline policy are required before air freight can be economically operated on a large scale. The airlines are loading their passenger planes to capacity with goods to be shipped to plants working on defense orders.

Some writers contend that for economical operation passenger and mail traffic should be separated from freight traffic. Passenger planes are designed for passenger comfort and speed. Cargo planes should be designed to lift large loads and carry them as economically as possible. The possibility of an economically sound air transportation system would be greatly increased by the use of specially designed cargo airplanes having a high ratio of pay load per horsepower and pay load per gross weight.

The present handling of freight is unsatisfactory and so expensive, five to seven times greater than railroad rates, that air freight is not being used except in emergency. To attract ordinary commerce and increase cargo traffic, rates must be reduced. The airlines have control over the rates, but their contracts require that the R.E.A. be notified of any change in rate and that air express charges must never be less than double first-class rail rates.

There are several different schools of thought regarding the handling of air freight. Many of the aviation experts who have long believed that air cargo would become the mainstay of civil air transportation feel that air express is now of sufficient importance to deserve an agency of its own which would devote all its efforts to the development of air freight. Others feel that the present system is satisfactory. It is interesting to note that in Europe two systems are used. Before the war the volume of air express carried by European airlines was greater than that carried by the airlines in this country. This was because of the high railway rates and insurance charges for railway express in Europe. Germany, in 1925, began an air-railway service similar to the system used in this country. Both Air France and British Imperial Airways operated their own pick-up-and-delivery service with their own trucks. Efforts are now being made to reconcile conflicting interests, so that development of air cargo in this country will not be retarded.

Recent developments indicate that the coming of the cargo plane will not be long delayed. A corporation, Air Cargo, Inc., has been formed by American Airlines, Eastern Air Lines, T.W.A., and United Airlines to study the possibility of developing the transportation of freight and express by air. This investigation will require about two years and is being made because these four companies feel that after the present war, the carrying of freight will become a far greater industry than it is at present. The cost studies and investigations of this new company are to be based on the development of new types of cargo planes. With cooperation of this kind between the airlines, this country after the present emergency will have the world's best air cargo service.

The formation of a cargo handler's school by United Air lines at its general headquarters in Chicago is a further indication of the growing importance of air freight. This school is being conducted through the joint efforts of the Boeing School of Aeronautics and United's personnel and mail and express departments. New employees will be taught the best methods of handling all forms of cargo, while the regular employees will be given a refresher course.

It is by no means visionary to picture that within a few years air freight in this country will be established on a basis similar to the railway freight and trucking industry with companies operating cargo airplanes only, and having their airports and terminals located near the centers of railroad and steamship facilities for trans-shipment. It is only necessary for the manufacturer and airline engineer to unite in solving cargo airplane design problems, as was done when the present passenger planes were developed, to enable air freight to take its place as a definite part of the vast freight transportation industry in the country.

ROBERT R. DEXTER

A Rising Curve of Flying History: Starting at the bottom are the First Martin Airplane, 1909; First U. S. Army Training Plane, 1913; First Martin Bomber, 1918; Martin B-10 Bomber, 1932; Martin B-26 Bomber, 1941.

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Now, out of the rich experience of the oldest and one of the largest aircraft manufacturers in the world, Martin B-26 Bombers are roaring from production lines in a swiftly mounting torrent of air power—joining the Army at a rate never before equalled in the production of large military air craft. *America is meeting the challenge!*

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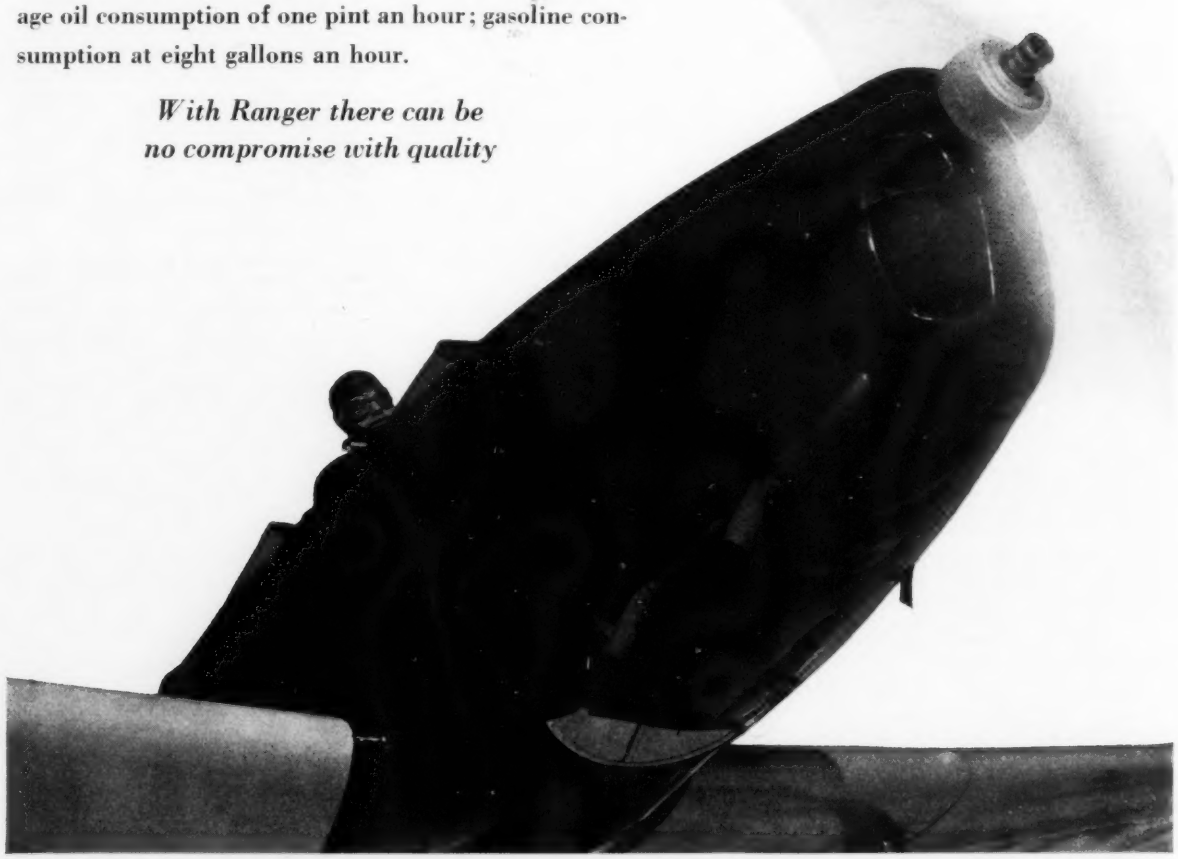

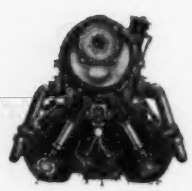

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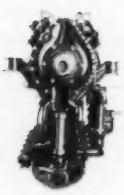

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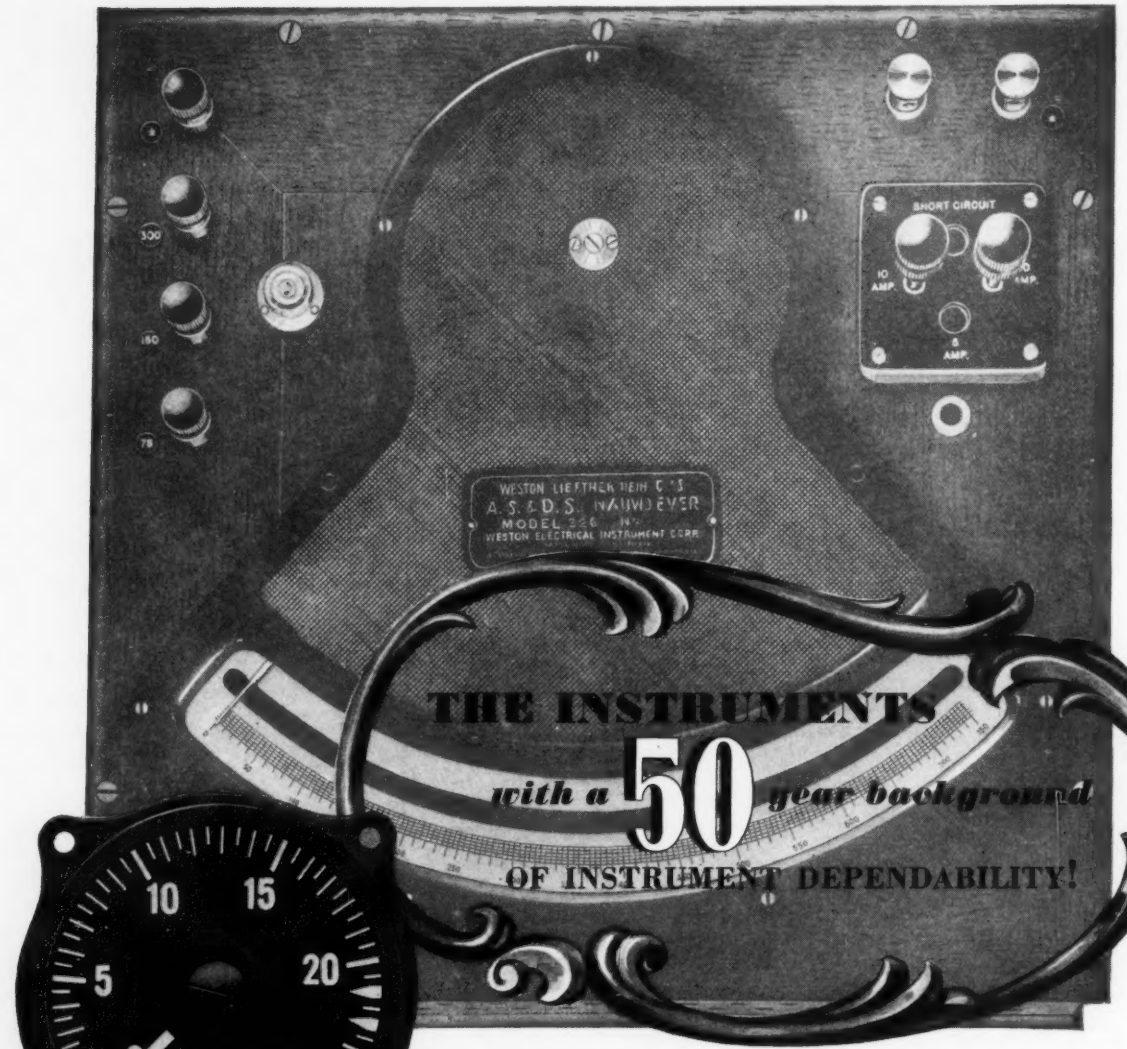

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FROM THE INDUSTRY

(*Continued from page 45*)

DO-X, the Dornier Flying boat, was the highest-powered aircraft until the B-19 was produced. The DO-X had 12 Curtiss Conqueror engines of 600 hp. each, or 7,200 hp. at take-off. However, it could not carry a payload of any size for more than a very short distance and it had practically no payload at all on flights of several hours or more. The B-19, however, has a bomb load capacity of 18 tons for its extensive flights.

The Cyclone 18 furnishing power for the big bomber is the direct descendant of a long line of Cyclones of the 9- and 14-cylinder types. Developed by engineers of the Wright Aeronautical Corporation and the Army Air Corps, the Cyclone 18 made its first public appearance two years ago in May, 1939, in a twin-engined seaplane which since then has been undergoing extensive service tests. Due to the large number of labor manhours necessary to produce a giant aircraft—700,000 man hours in the B-19—the engine was available for a considerable length of time before there were airplanes ready to use it.

The engine was at one time called the Cyclone Duplex or the Duplex Cyclone 18, but now it is officially known as the Cyclone 18, continuing the title of the well-known series.

Despite its tremendous power and its extra cylinders, the Cyclone 18 has approximately the same over-all dimensions as the Cyclones of fewer cylinders. The cylinders on the new engines have unusually deep and closely spaced cooling fins, giving each engine a cooling area about twice that of a normal-sized living room. The engine also has the same ratio of weight to horsepower, about 1.1 lbs. per hp., as in other Cyclones.

The propeller reduction gears are of a new type to meet the requirements of the latest type of propellers. The power section is the strongest ever produced and allows ample margin for the future power increases already planned. The internal oil system is entirely new to meet the problems arising when flying at very high altitudes.

While the frontal area of the engine is the same as in other models, the nose section has been considerably lengthened to take advantage of modern aerodynamic research which indicates that better performance comes from the elongated ring cowl shape made possible by lengthening the nose section.

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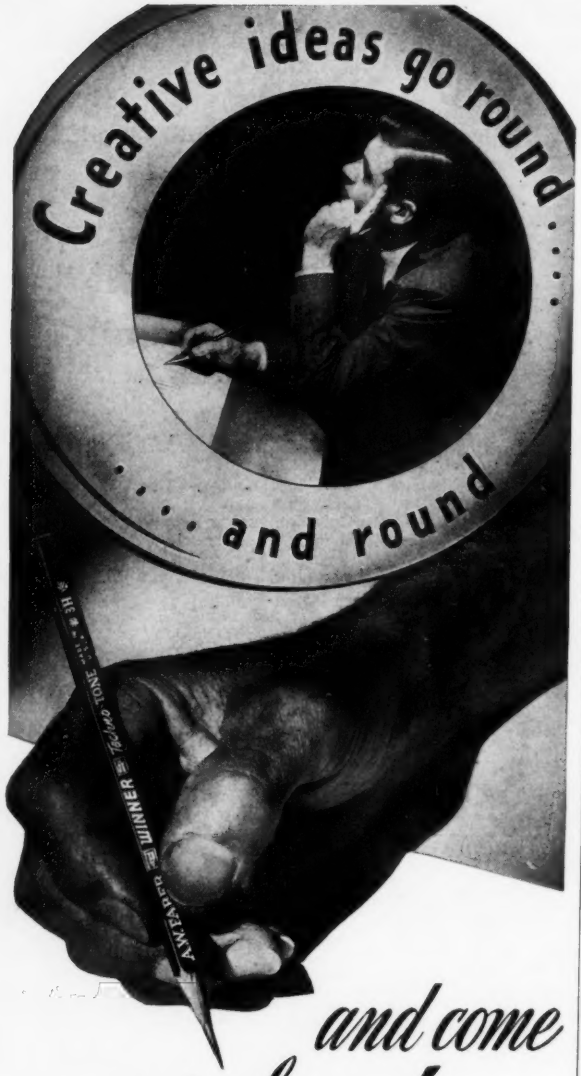

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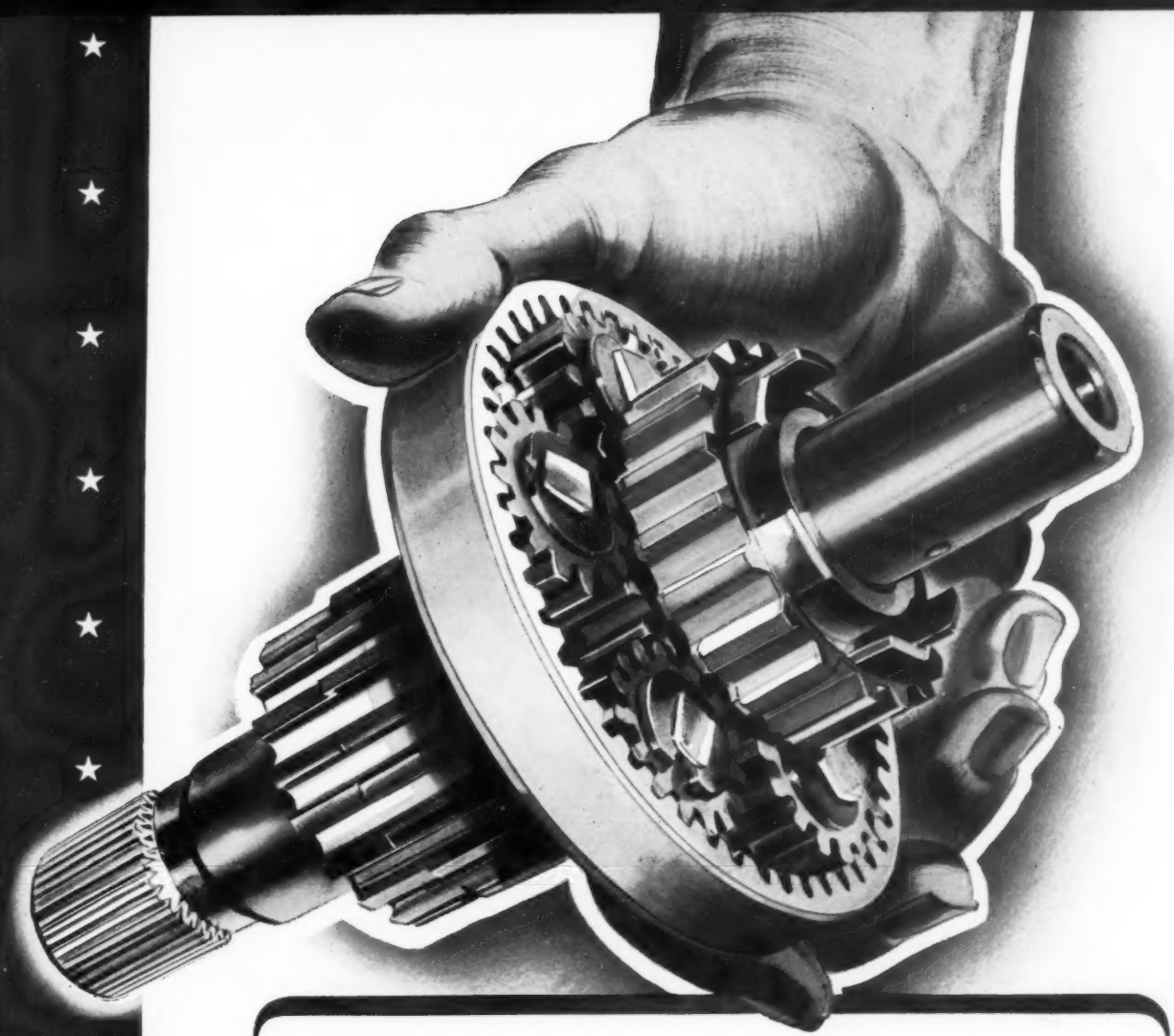

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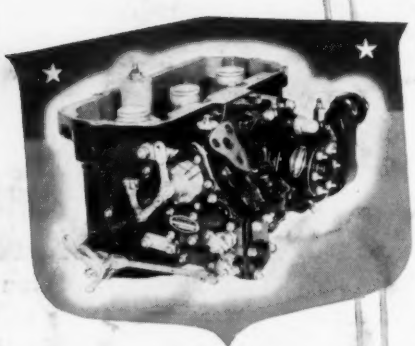

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